AD-A094 798 CENTER FOR NAVAL ANALYSES ALEXANDRIA VA INST OF NAVAL--ETC F/G 5/3
EFFECTS OF TRADE RESTRICTIONS ON IMPORTS OF STEEL.(U)
NOV 80 J M JONDROW
UNCLASSIFIED CNA-PP-165 NL

1 OF 1
AD A
094798

END
DATE
FILMED
3-81
DTIC

Professional Paper 165/Nov. 1980

LEVEL

2

EFFECTS OF TRADE RESTRICTIONS ON IMPORTS OF STEEL

James M. Jondrow

CENTER FOR NAVAL ANALYSES

PROFESSIONAL PAPER 165 / November 1980

EFFECTS OF TRADE RESTRICTIONS ON IMPORTS OF STEEL

James M. Jondrow

CNA Institute of Naval Studies

The Public Research Institute

A Division of the Center for Naval Analyses

2000 North Beauregard Street, Alexandria, Virginia 22311

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Introduction

Harry Grubert

The papers in this session are two examples of a series of industry studies by the Bureau of International Labor Affairs. In addition to these two, studies have been completed on oil, footwear and sugar, and are under way on chemicals and electronics. Each of these studies takes a close look at the special features of a particular industry in contrast to some of the more broad ranging projects reported in other sessions.

The steel project reported by Mr. Jondrow for the Public Research Institute was the first major industry study undertaken by the Bureau of International Labor Affairs (ILAB). It was intended as a prototype for the series in the sense that its components would tend to be found in the other industry studies. These industry study elements are (1) an analysis of the responsiveness of import demand to relative prices; (2) the determinant of domestic and foreign prices; (3) the relationship between changes in domestic output and employment; and (4) the estimation of losses in lifetime earnings incurred by displaced workers in the industry. This last area, earnings losses, is one in which ILAB research has pioneered. It is reported on more fully in the paper by Louis Jacobson in the session on labor adjustment.

Although each of the industry studies tends to have similar components, the paper by Eric Toder on automobiles demonstrates that every industry has special features which necessitate differences in the analysis. In automobiles, the differences in characteristics among makes of cars and the differing tastes of consumers for these characteristics create special problems. A time series analysis relating imports to the relative prices of imported and domestic cars is not entirely adequate. It is not enough to adjust price indices for the changing characteristics of cars using so-called hedonic methods which make adjustments for differences in characteristics. For not only will demand for imports depend on relative prices, holding quality constant, but also on how many makes of particular types of cars are available. For example, there may be a switch to domestics if U.S. producers start to make cars that are closer to foreign automobiles in terms of size and performance. Because of the need to enrich the demand analysis, the automobile project developed the hedonic share model described by Mr. Toder.

In part because of the variety of consumer tastes, economies of scale seem to be significant in the automobile industry. The study, therefore, found it necessary to make a close examination of the minimum efficient scale for automobile plants. This information, in turn, becomes important in predicting what kinds of cars will be produced in various locations. For example, Mr. Toder suggests that as the market for German and Japanese small cars expands in the United States, Japanese and German producers may well find it efficient to establish plants in this country, a development that, of course, has already started.

Returning to demand for a moment, I do not wish to imply that the analysis of demand for steel is particularly straightforward. Indeed the apparent uniformity in quality between foreign and domestic steel raises a question of its own. Why do foreign and domestic steel sell at different prices at any time, and further, why does the price differential change substantially, as it does, over time? Mr. Jondrow has examined this problem in a follow-up study that is just being completed and found that foreign and domestic steel are not really identical products from the purchaser's point of view. Foreign steel takes much longer to get delivered after being ordered, and the delivery lag is more variable. Moreover, the buyer who depends on foreign steel will experience greater variability in price. These factors increase inventory and other costs which means that many customers will be willing to pay a substantial premium for domestic steel.

It may be useful for me to point to a few similarities and contrasts in the auto and steel study results. Both find that the price elasticity of the demand for imports is relatively low in the short run, but seems to be very large in the long run. On the other hand, domestic price setting behavior in the auto and steel industries seems to differ. It is estimated that domestic steel prices are unaffected by changes in import prices, but that domestic automobile prices respond to import competition significantly. The automobile study did not investigate the formation of foreign prices, but the steel results are of interest. Mr. Jondrow finds that import prices are highly responsive to capacity utilization abroad, in contrast to domestic steel prices which appear unaffected by demand conditions, a contrast which Professor Houthakker specially notes in his comment.

In conclusion, I would like to emphasize the fact that the objective of these studies is to improve the evaluation of trade policy. When changes in trade barriers are considered, it is critically important to know how domestic demand responds to import costs, how employment will be affected, and what will be the impact of the labor market experience of workers in the industry. The two industry studies presented here are an attempt to expand the amount of available information on these questions.

Effects of Trade Restrictions On Imports of Steel

James M. Jondrow*

Introduction and Summary of Results

In analyzing the relative merits of free and restricted trade, economists have tended to concentrate on the net long-run effects: whether the long-run gains to one group exceed the losses to others. This paper uses an econometric model to estimate the short-term gains and losses to particular groups from free trade in the steel industry. Because there has not been free trade, we studied what would have happened had there been free trade in the period 1969–73.

During 1969–73, there were two trade barriers. One, a tariff of about 7 percent, had existed for a long time, but was declining because of the Kennedy Round agreements. The other, a voluntary quota starting in 1969, had been accepted by Japan and the European Common Market, the major steel exporting countries.

One central finding of the study is that removal of import barriers would not have led to a sudden shrinkage of the domestic industry. Import penetration would have built gradually. In the first year of our period of study, imports would have displaced less than 2 percent of domestic shipments. This percentage displacement would have increased gradually to about 8 percent four years later.

Employment would have been reduced more than proportionately to output because the oldest, most labor-intensive equipment would have been most affected. The employment reduction would have been gradual, and would have come about, in part, by attrition. Still, there would have been some layoffs. We estimate that removal of trade barriers would have induced annual layoffs in the first years, averaging to roughly 3 percent of the labor force. On the average, each displaced worker would have lost in lifetime earnings an estimated $6 thousand (in 1960 dollars).

There would have been losses to the steel industry. In the year of greatest effect, losses to industry would have amounted to about 3 percent of gross revenue and would have approximately eliminated net income in that year.

Removal of import barriers would have generated gains to purchasers of imported steel. These gains, in the form of lower prices, would have accrued both to industries using steel and to consumers of steel-using products. We estimate that these gains would have more than offset the total losses to steel workers and the domestic industry.

The Historical Context

Before 1958, imports were not much of a challenge. Then in the late 1950s, the import price dropped sharply from well above the domestic price to about 15 percent below. The import price remained 10 percent to 20 percent below the domestic price during most of the next ten years, whereas the import share grew from less than 2 percent to almost 17 percent in 1968.

Several reasons have been offered for the weakening of the domestic steel industry's competitive position. The "over-valuation" of the dollar has been suggested by Floyd [8] as a cause for the U.S. trade deficit in general and by Thompson [15, p. 87] as a cause of growth in steel imports.

In addition, American comparative advantage may have been shifting away from steel. The steel industry in the United States, relying on relatively old plants, had lost some of its technical superiority over foreign producers. Evidence for this position offered by Dirlam and Adams [2] is the slower U.S. adoption of the basic oxygen furnace. In addition, foreign steel industries had begun to recover from World War II. Thorn [14] suggests that the U.S. industry also faced much higher wage costs than their foreign competitors.

A source of import penetration not related to comparative advantage is the existence of "excess" capacity in foreign countries [15, pp. 17–27]. Another is the policy of the domestic steel industry to hold prices constant in the face of import competition [1, pp. 627–29]. Indeed, when imports precipitated a temporary price war in 1968, the press commented that price

---

*This paper is based on "Removing Restrictions on Imports of Steel," II.AB 73–8 by James Jondrow, Eugene Devine, Louis Jacobson, Arnold Katz, and David O'Neill, Public Research Institute, Center for Naval Analyses, 1975

cutting was a tactic domestic firms had long avoided [16].

Finally, American labor disputes encouraged imports. The first major inflow of imports coincided with the record 116-day steel strike in 1959. To replace lost domestic shipments, purchasers turned to imports, more than doubling import tonnage. After the strike, the import share did not return to its pre-strike level, perhaps because American purchasers had gained familiarity with imports.

Throughout the sixties, the persistent import price advantage led to a steady increase in the import share but, in addition, import penetration always increased when a strike was threatened.

By 1968, the import share had reached a peak of almost 17 percent. Though part of this was due to hedging before a possible strike, it still generated concern in Congress. To head off a possible mandatory quota, the major exporting countries agreed to the voluntary quota.

The quota covered the five years 1969–73. Since import penetration was still increasing when the quota was instituted, a stable equilibrium had not been reached. The effect of the quota was to limit further import penetration.

The quota was not the only factor limiting imports in this period. Higher world demand (especially in 1969 and 1973), increasing foreign labor costs, and dollar devaluations all would have played a part if the quota had not been in effect. In the final year of the quota, 1973, these factors created such a high import price that the quota was not binding.

There have been violent cyclical swings. During late 1973 and 1974, there was an extreme worldwide shortage in steel, resulting in import prices far above the domestic price. Then, in 1975, world demand fell sharply and the import price fell below the domestic. The fall in U.S. demand was accentuated by consumer inventory rundown and the resulting drop in domestic mill shipments was unprecedented in the postwar period. As world markets recovered in early 1976, the import price approached the domestic price, but since then, the import price has again fallen below the domestic.

One of the most striking facts about the steel industry's long period of vulnerability is that import penetration was so slow. Although the penetration was unrelenting, imports never threatened to take over the market.

An Overview of Methods Used to Estimate The Effect of Free Trade

Our estimate of the effect of removing the tariff and quota begins with an analysis of competition between imported and domestic steel. Statistical relations are estimated which represent the behavior of participants in the steel market, domestic steel purchasers, domestic suppliers, and foreign suppliers. These relations are used to estimate the hypothetical effect of removing restrictions on steel imports in 1969 and leaving them off through 1973. The effects are summarized as differences due to free trade in domestic shipments, prices, import shipments, and import prices.

The estimated effect on domestic shipments is then used to estimate employment and earnings, and to estimate the effect on the welfare of particular groups.

The next section describes some of the data used for estimation. This is followed by a more detailed description of the methodology and results.

The Data Used for the Study

Much of the data used in this study was taken from standard sources. For example, tonnage figures for imports and domestic shipments were available from the American Iron and Steel Institute *Annual Statistical Report*. These series are reprinted in the Commerce Department's *Survey of Current Business*. Some important data were not available from government statistical series; as a result, we found it useful to go to basic sources.

For example, there is no U.S. government price index for imported steel. Perhaps the closest measure is the unit value of imported steel, the customs value divided by import tonnage. This is not very accurate, however, since a shift from lower to higher valued steel will increase the unit value, even if the actual price is unchanged. In addition, the valuation for a given item can be determined in a number of ways and "frequently does not reflect the actual transaction value" [11, p. 1].

To construct an import price index, we used trade press quotations of export prices for Japan and the Common Market. These prices are published for particular types of steel in the British trade journal, *The Metal Bulletin*. The individual prices were weighted and aggregated into a single index of the foreign dollar export price.

To this export price, we added transport and tariff costs to approximate the U.S. landed price. The transport cost index was constructed from data in *Chartering Annual* [5]. The percentage tariff was constructed as a fixed weighted average of numerous individual tariffs.

We also needed basic data to form an index of foreign materials cost. Such an index was readily available for Japan, since the Japanese government publishes a set of input output price indices for various industries, but for

Europe, it was necessary to create an index of steel input costs from price indices for separate factors. (German factor prices were used to represent European costs.)

A More Detailed Description of Methods Used to Estimate the Effect of Free Trade on Prices and Output

The economic model of the steel market used to estimate the impact of free trade has four behavioral equations. The first two describe demand: the substitution between imported and domestic steel and the substitution between steel and other products. The remaining two behavioral equations describe supply: price setting behavior by producers of domestic and imported steel. The model is completed with several identities.

The following sections give a general description of the equations and results. The equations themselves are presented in Appendix A.

Substitution between imported and domestic steel. The first equation describes the choice between domestic and imported steel. The variable to be explained is the ratio of imports to domestic shipments.

An important determinant is the import-domestic price ratio, an index of landed import price divided by an index of the domestic steel price (represented by the BLS price index for steel mill products). It is estimated that, if trade restrictions increase the relative import price by 1 percent, the dependent variable will fall by 1 percent during the first year. This effect is statistically significant; its level is almost eight times its standard error.

The relative price variable measures only the short-run effect of prices. To represent the lagged effect of prices and other variables, we include several lagged values of the dependent variable, which allows the effect of a persisting price change to cumulate.

Table 1 illustrates the cumulative effect of a 1 percent drop in import price.

Table 1

Cumulative Effect of a 1 Percent Fall in the Price of Imported Steel on the Ratio of Imports to Domestic Shipments

	Percent Change in the Ratio
First year	1.0
Second year	1.5
Third year	1.9
Fourth year	2.3
Long-run effect	5.9

Another important determinant of the import-domestic quantity ratio is the expectation of a strike. When a strike is expected, consumers often turn to imported steel because of limitations on domestic capacity and because deliveries during a strike can be guaranteed only by import suppliers. The estimated equation indicated that a period of hedging against a strike, such as the one in 1968, would increase the dependent variable by about 3 percent.

Substitution between steel and other products. In addition to encouraging substitution into imports from domestic steel, free trade also encourages substitution into steel from other products. The second equation describes the degree of substitution into steel, estimating how consumption of steel changes when the price of steel falls.

The dependent variable in this equation is a measure of the total amount of steel, domestic and imported. The measure is not the sum of the two types of steel, but a slightly more complex magnitude based on the assumption that the two are imperfect substitutes with a constant elasticity of substitution.

This dependent variable turns out to have only a limited sensitivity to the price of steel as a whole. A 1 percent drop in the price of steel, relative to the price of steel-using output, leads to a 0.4 percent rise in steel shipments. Even if free trade lowers the price of steel, steel consumption will not increase much.

Other determinants of steel demand are output in steel-using industries and lagged steel shipments. Output has a powerful effect, indicating that steel is a highly cyclical industry. Lagged steel shipments have a negative effect. This probably indicates inventory adjustments. A high value of last year's shipments, holding constant this year's desired consumption, means that inventories will need to be reduced this year, reducing this year's shipments.

Inventory adjustment seems to have been partially responsible for the precipitous drop in steel shipments in early 1975. Inventories built by purchasers trying to protect themselves against the shortage in late 1973 and 1974 and the expected 1974 coal strike were liquidated in early 1975 as demand dropped.

The remaining determinant of steel demand is a simple time trend with a negative effect of about 1.8 percent a year. The trend may represent the discovery of new applications for competing materials such as plastics, cement, and aluminum.

The supply price of domestic steel. The variable to be explained is the BLS Wholesale Price Index for steel mill products. Imports could affect the domestic price by creating slack in the demand for domestic steel. However, we did not find that capacity utilization was an important determinant of price, which suggests that

domestic price will not fall sharply to limit import penetration. This result does not seem to stem from inaccuracies in the price measure. The one major study directed toward measuring the extent of discounting found it unimportant for steel [13, pp. 72–74]. Variables that did seem to affect price were input costs and the price in the previous year.

The supply price of foreign exports. This equation explains an index of the foreign export price. The major issue is whether this export price is affected by U.S. import demand. If so, then trade restrictions will tend to lower the foreign export price.

U.S. demand can affect the export price either as part of world demand or through some independent mechanism. The empirical analysis suggests that our demand is important only as part of world demand, not independently. Entering our demand as a determinant of foreign export price did not yield successful results. Since our import demand is only a small part of world demand, the export price does not depend importantly on U.S. import demand. Hence, foreigners are unlikely to bear a large fraction of any burden imposed by trade restrictions.

Though our import demand does not influence the foreign export price, world demand does. We estimated that a 10 percent increase in world capacity utilization raised foreign export prices by almost 20 percent. Foreign materials prices and technical change also influenced the foreign export price.

The effect of the quota was measured within the import price equation. The presence of the quota was measured by dummy variables for the quota years 1969 to 1972. A quota variable was not included for 1973, since the quota was nonbinding in that year.

The coefficients on the quota variables are estimates of the tariff equivalent of the quota, i.e., the tariff that would restrict imports the same amount. This tariff equivalent ranges from 19 to 28 percent depending on the year; the same order of magnitude as those reported by Floyd [7, p. 133]. His estimate is based on comparisons of prices of Japanese steel in Canada and the United States.

In interpreting the estimated tariff equivalent, we note that the dependent variable is a posted world export price, not necessarily specific to U.S. purchasers. Foreign producers with rights to sell under the U.S. quota receive a monopoly rent, creating a difference between the world export price and the price to the United States. The question is, Which price is measured by posted prices during the quota period?

We answered this question empirically. We entered the quota variables in both the export price relation (as discussed in this section) and in the import-domestic substitution relation. If the quota rent is included in posted prices, the quota variables should be significant in the export price equation. If the quota rent is not included, the quota variables should be significant instead in the import demand equation. That is, actual import prices to the United States will be underestimated by posted prices during the quota period and the quota variables will pick up this underestimation. Thus, they will be significant determinants of the ratio of imports to domestic tonnage in the import demand curve.

The results indicated that the rent attributable to the U.S. quota was included in the posted price during the

Table 2

The Estimated Effect of Import Restrictions 1969–73

Year	(1) Actual	(2) Predicted with Trade Restrictions	(3) Predicted without Trade Restrictions	(4) Effect of Trade Restrictions as a Percent of Column (2)
		Imports of Steel Mill Products (in thousands of net tons)		
1969	14,034	13,600	16,900	−25
1970	13,364	12,000	16,100	−34
1971	18,304	16,800	26,000	−54
1972	17,681	17,300	27,500	−58
1973	15,152	14,600	21,800	−48
		Domestic Shipments of Steel Mill Products (in thousands of net tons)		
1969	93,877	98,600	97,100	1.5
1970	90,798	90,770	87,900	3.1
1971	87,038	87,800	81,800	6.8
1972	91,805	95,400	87,700	8.1
1973	111,430	111,000	103,163	6.8
		Import Price (index base 1967)		
1969	1.27	1.33	1.04	21
1970	1.36	1.38	1.10	20
1971	1.15	1.15	0.86	26
1972	1.29	1.27	1.03	19
1973	2.09	1.98	1.87	5
		Import Share		
1969	0.14	0.13	0.16	−23
1970	0.14	0.13	0.17	−33
1971	0.18	0.17	0.25	−50
1972	0.17	0.16	0.25	−55
1973	0.12	0.12	0.18	−49
		Capacity Utilization		
1969	0.93	0.97	0.96	1.5
1970	0.86	0.86	0.83	3.1
1971	0.78	0.79	0.74	6.8
1972	0.87	0.90	0.83	8.1
1973	0.98	0.97	0.90	6.8

quota period and other purchasers received discounts from this. This result is consistent with the fact that quoted prices usually refer to the maximum price where different purchasers pay different prices. Note that it is also consistent with the foreign exporters receiving the quota rent.

Identities. The behavioral relations discussed above are supplemented with several identities. One shows the exchange rate conversion between the export price in foreign currency and the export price in dollars. Another adds transport costs and the tariff to the foreign dollar export price to form the landed import price, the price used to estimate substitution between imported and domestic steel.

The Impact of Free Trade

The model outlined above was used to estimate how free trade would affect the U.S. steel market between 1969 and 1973. As shown in Table 2, we estimate that imports would have been much higher had trade barriers not existed. Import tonnage would have grown to an estimated peak of 27.5 million tons in 1972 compared with the 17.3 million tons actually imported.

The effect of trade restrictions was to limit the import share to about the prequota level (see Figure 1). The restrictive effects of the tariff and quota increased over time; they are estimated to have reduced imports by 25 percent in the first year and by almost 60 percent in 1972, the year of the peak effect.

Trade restrictions had a major impact on import price, as much as 25 percent in some years; yet imports are a small fraction of U.S. consumption, so a substantial restriction of imports still does not translate into a large percentage increase in domestic shipments. In fact, we estimate that the largest increase in domestic shipments due to the tariff and quota was 8 percent. Had there been no trade restrictions, the main effect of import penetration would have been to accentuate the cyclical downturn in domestic steel shipments in 1970–72: 1970 would have remained a mediocre year; 1971 would have become a very weak year; and 1972 would have been a mediocre rather than a good year.

The effect on employment. Still to be determined is how the output changes described above would affect employment, and the welfare of specific groups. To convert output changes to employment changes, we used the work of Arnold Katz of the University of Pittsburgh. Katz's research describes the way in which

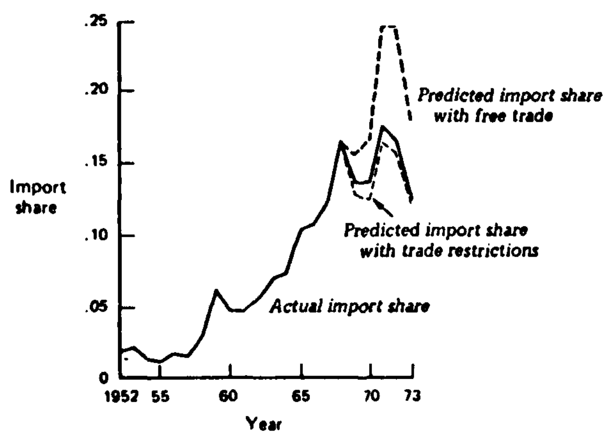

Figure 1

The Share of Imports in Apparent Consumption — Actual, Predicted with Free Trade, and Predicted with Trade Restrictions

labor requirements depend on the age of the capital stock [11]. Older plants tend to be more labor intensive than the industry's average plant, and hence have higher variable costs. These are the plants most likely affected by the trade, hence employment losses are more than proportional to output changes. Indeed, Katz has estimated that the older, marginal plants are about twice as labor intensive as the industry average, so that a permanent 1 percent drop in output leads to a 2 percent drop in permanent employment.

The permanent employment effect of output changes is delayed by labor hoarding, which explains why employment varies less than output over the cycle. A business will generally not know whether an observed drop in demand is permanent. If it is judged to be temporary, laying off workers may be costly; some will find other work. Increasing output back to "normal" requires hiring new workers with attendant search costs and training costs. Because of these costs, management tends to delay some layoffs until it becomes sure that the fall in demand is permanent. Katz estimates that, in the steel industry, only 50 percent of any long-term employment drop is made in the first year of declining demand. The remaining half is delayed until the second year.

We applied Katz's model to translate output changes to employment changes. First, actual employment was assumed to be desired employment in the presence of trade restrictions. (Note, this implicitly ignores labor hoarding in the actual employment figures). Experiments with relaxing this assumption tended to lower the costs of free trade (leaving the gains unchanged). To derive desired free trade employment, we adjusted actual employment by the estimated percentage effect of free trade on employment, twice the percentage output effect.

Table 3

Employment Estimates With and Without Free Trade

Year	(1) Predicted Employment with Trade Restrictions	(2) Predicted Employment with Free Trade	(3) Effect of Trade Restrictions as a Percent of Column (1)
	Employment in SIC 331 (Adjusted for manhours) thousands of workers		
1969	659.8	643.6	2.5
1970	628.4	589.4	6.2
1971	578.1	544.5	5.8
1972	584.4	494.6	15.4
1973	628.4	518.8	17.4

The desired employment under free trade was then adjusted to allow labor hoarding. Using Katz's result, we assumed that in the first year the firm retains one-half of the workers it intends finally to lay off. If, in the next year, demand does not return to "normal," workers hoarded from the previous year are laid off, and one-half of the new employment adjustment is made. We used the employment figures, after labor hoarding, to estimate layoffs with and without free trade. In doing this, we subtracted an assumed 1.5 percent natural attrition.

As can be seen from Table 3, the effect on employment cumulates because of gradual adjustment in domestic output and because of labor hoarding. The effect on layoffs (Table 4) was much smaller. Only in two of the five years in which the quota existed would free trade have increased estimated layoffs. In 1970 an additional 3.5 percent of the industry's labor force would have been laid off. In 1971 the estimated difference is 8.4 percent of the labor force.

The effect on welfare of specific groups. Gains and losses to specific groups include:

- gain to steel purchasers
- loss to steel manufacturers
- loss to steel workers
- loss of tariff revenue.

The gain to consumers is estimated using a standard technique, consumer's surplus (see Appendix B).

Table 4

Layoff Estimates With and Without Free Trade

Year	Predicted Layoffs with Trade Restrictions	Predicted Layoffs with Free Trade	Effect of Free Trade as a Percent of Employment
	(Layoffs in thousands of workers)		
1969	0	0	0
1970	21.5	44.6	3.5
1971	40.9	36.1	−0.01*
1972	0	41.6	8.4
1973	0	0	0

*Though estimated layoffs are generally higher under free trade, there is one exception. Free trade layoffs in 1971 are slightly below layoffs with trade restrictions. This results from the fact that labor hoarding is taken into account in the free trade case, but not in the actual employment figures used to represent the situation with trade restrictions. Labor hoarding under free trade spreads the desired employment drop over two years, making the 1971 free trade layoffs smaller than with no trade restrictions. The delayed layoffs under free trade show up in 1972.

The loss to steel manufacturers is of two types. First there is the cost of labor hoarded. We assume that this labor is not used, so that the loss to industry is the salary of the hoarded labor, which undoubtedly overstates the cost to industry since the extra labor probably has some productivity.

There is also a further loss of profits. This is the area above a competitive supply curve, or marginal cost curve, usually termed producer's surplus. We did not observe an upward sloping supply curve for steel in our empirical work; instead we found that the price is unresponsive to market conditions. However, Katz's work on costs for equipment of different ages suggests a shape for the marginal cost curve, which can be used to estimate profit losses.

Losses to labor were estimated by comparing the long-term earnings of displaced steel workers with the earnings of similar workers who remain. Jacobson [9] estimates that the lifetime earnings losses per steel worker laid off are $6,300 in 1960 dollars. To get total costs, we adjusted this figure to 1969 dollars using the wholesale price index (as used throughout the paper) and multiplied it by the number of layoffs induced by free trade. Losses of tariff revenue are estimated as import values (at the foreign port) multiplied by the percentage tariff. The estimated gains and losses to specific groups are shown in Table 5.

The discounted sums shown in Table 5 are present values in 1969 dollars. Gains and losses for individual years are first deflated to 1969 dollars using the wholesale price index, then discounted back to 1969, using a real interest rate of 5 percent.

As can be seen from the table, gains to steel consumers are sizeable, about $2.8 billion. Much of this is a transfer from other groups. The largest losses are not to labor, but to shareholders in the steel industry. They lose about $1.1 billion in profits, which includes about $0.85 billion due to labor hoarding. Losses to taxpayers in tariff revenue are another $0.7 billion, and losses to labor are a somewhat more modest $0.4 billion.

Adding the gains and losses yields a net gain of about $0.62 billion. If redistribution is thought to have some cost, this net gain is not costless. The net gain necessitates a transfer of about $2.2 billion, or over three times the net effect. Part of this transfer is from taxpayers, not a concentrated group. The transfer from labor and industry is about $1.5 billion, more than twice the net effect.

Though the adjustment for free trade requires losses that are large in relation to the net gains, the losses are not sudden, nor are they large in relation to industry revenue or payroll.

In the worst year for layoffs, the expected lifetime earnings loss was less than 5 percent of payroll. The

Table 5

Gains and Losses Due to Free Trade

Year	Gains to Steel Purchasers (millions)
1969	$539
1970	610
1971	1048
1972	903
1973	267
Discounted sum	2839
	Losses to Workers (millions)
1969	$ 0
1970	170
1971	−36
1972	329
1973	0
Discounted Sum	379
	Losses to Industry from Labor Hoarding (millions)
1969	$ 43
1970	300
1971	578
1972	73
1973	0
Discounted Sum	864
	Losses to Industry Producer's Surplus (millions)
1969	$ 1
1970	38
1971	141
1972	95
1973	30
Discounted Sum	249
	Losses of Tariff Revenue (millions)
1969	$141
1970	151
1971	195
1972	205
1973	189.
Discounted Sum	726
	Total Gains Minus Total Losses (millions)
	$621

largest single year loss to industry was modest in relation to revenue, about 3 percent; however, it would have exhausted net income that year.

Some of the losses described above do not usually appear in calculations of the net gains from trade. The loss to industry in the form of payments for hoarded labor is usually not included, on the assumption that the industry moves immediately to its new equilibrium level of employment. One argument for this is that labor hoarding is a purely cyclical phenomenon. On the other hand, it seems unlikely that the effects of permanent output changes can be distinguished easily from cyclical changes. Hence, the uncertainty and reaction to it might be similar.

Also omitted from the usual gains and losses calculation is the loss of industry profits and labor earnings. The rationale is that a competitive supply curve represents the opportunity costs for both labor and capital. Hence, any losses they would suffer are completely included in the steel price drop they are willing to accept. But, it turns out, this loss is exactly offset by a gain to consumers of the domestic product. The gains to consumers of the domestic product and the losses to capital and labor cancel, leaving a net gain only to *consumers* of the imported product.

We do not assume this cancellation for the steel industry because neither the steel price nor wage seems sensitive to short-run demand conditions. Yet, the existence of marginal plants alongside much more modern ones suggests that the industry has an upward sloping marginal cost curve, as discussed earlier.

We limited our study to specific years and to gains and losses to specific groups. A word should be said, however, about the welfare effects that lie outside this focus. First, if import penetration causes an adjustment in the exchange rate, or a downward adjustment in the general domestic price level, our exports will become more competitive. If the United States has monopoly power in export markets, import trade restrictions will help us exploit this and shift the terms of trade in our favor. Removing import restrictions prevents us from exercising our monopoly power as effectively. We have not taken account of this.

On the other hand, the gains to import consumers will extend indefinitely into the future. The adjustment costs to industry and labor, all the costs but the lost tariff revenue, will die out as adjustment becomes complete. Hence, limiting the study to the first few years of free trade could lead to massive underestimates of the net gains.

Appendix A

Equations Used to Describe the Steel Market

The results in the text are based on an econometric model. The model has four behavioral equations (discussed below) and a number of identities.

Background on the demand curves. There are two demand equations, one representing the substitution between imported and domestic steel, the other representing the demand for steel as a whole. These equations are derived from a CES production function for steel-using commodities y. The production function is assumed to be of the following nested type, as described in [4].

$$y = A\left\{b_1 s^{-\alpha} + b_2 x^{-\alpha}\right\}^{-1/\alpha},$$

$$s = \left\{c_1 q^{-\beta} + c_2 m^{-\beta}\right\}^{-1/\beta}.$$

The first production function is homogeneous and depends on an index of steel input s, constructed as a CES function of m (import tonnage) and q (domestic shipments to domestic purchasers). The coefficient α *measures* substitutability between steel and other inputs, the elasticity of substitution being $\delta = (1 + \alpha)^{-1}$. Similarly, the coefficient β represents substitutability between imported and domestic steel.

Profit maximization by firms, taking as given the price of output, results in the following factor demand equations:

$$\frac{m}{q} = \left(\frac{c_2\ p_q}{c_1\ p_m}\right)^{\sigma} \text{ or}$$

$$\ln\left(\frac{m}{q}\right) = \sigma \ln\left(\frac{c_2}{c_1}\right) + \sigma \ln\left(\frac{p_q}{p_m}\right), \tag{1}$$

$$s = k\left(\frac{p_y}{p_s}\right)^{\delta} y \text{ or}$$

$$\ln(s) = \ln k + \delta \ln\left(\frac{p_y}{p_s}\right) + \ln(y), \tag{2}$$

where

p_m = price of imported steel
p_q = price of domestic steel
p_y = price of output

λ = constant

σ = $(1 + \beta)^{-1}$

δ = $(1 + \alpha)^{-1}$

p_s = composite price for steel, which can be defined by the relation $d \ln p_s = v_m d \ln p_m + (1 - v_m) d \ln p_q$, where v_m is the import value share

y = output of steel-using commodities.

For estimation, both (1) and (2) are assumed to hold in long-run equilibrium. Actual estimation employs lagged values of left-and-right-hand variables to allow for gradual adjustment. These short-run forms approach (1) and (2) as adjustment becomes complete.

Before proceeding to estimates of individual equations, it is necessary to discuss a general econometric issue. The model includes almost as many predetermined variables as observations. Hence, two-stage least-squares is virtually the same as ordinary least-squares. Obvious alternatives are to use a subset of the predetermined variables or a set of principal components. However, the first seems arbitrary and involves throwing away information. The latter is subject to the scale problem. Moreover, the endogenous right-hand variables turn out to be not very endogenous. Hence, the low variance of least-squares may well outweigh its asymptotic bias. For these reasons, ordinary least-squares is used for estimation. To correct for first-order serial correlation, generalized least-squares is employed.

The substitution equation. The substitution equation (equation (3)) is estimated using a Jorgenson rational lag (hence the lagged values of m/q) and an added variable H to measure hedging before a possible strike. Before each major negotiation, steel users build inventories, domestic shipments become large, domestic capacity often proves inadequate, and users often turn to imports. After the agreement is reached, domestic shipments fall off suddenly. A measure of the hedge's intensity is the ratio of maximum monthly shipments during the year to average monthly shipments. Our variable H is this ratio multiplied by the estimated length of the hedge. The length measure is provided in the 1968 *Steel Import* study [15, pp. 149 - 56] with our own extensions for more recent years.

Equation (3): Substitution Equation — Annual Data 1956–73 (t values in parentheses)

$$\ln\left(\frac{m}{q}\right) = \underset{(-3.00)}{-0.394} \quad \underset{(7.93)}{0.994} \ln\left(0.84\,\frac{p_m}{p_q}\right)$$

$$+ \underset{(6.74)}{0.454} \ln\left(\frac{m}{q}\right)_{-1} + \underset{(3.21)}{0.265} \ln\left(\frac{m}{q}\right)_{-2}$$

$$+ \underset{(1.56)}{0.113} \ln\left(\frac{m}{q}\right)_{-3} + \underset{(7.61)}{0.037}\, H .$$

R^2 (on transformed data) = 0.98

N = 18

d.f. = 12

D-W = 1.79

ρ = 0.542,

where

m = tonnage imports of steel mill products

q = domestic tonnage shipments of steel mill products to domestic users

p_m = index (base 1967) of the dollar price of imports including tariff and transport. It is constructed from export quotations for the common market and Japan. These export quotations were used to form a fixed weight measure of the dollar export price. To this we added a measure of tariff and transport costs. The former was based on a fixed weight average of U.S. steel tariffs. The latter was based on an index of tramp steamer rates published in [5]. The dollar import price, thus formed, was then expressed as an index, base 1967. In estimation, the index is multiplied by 0.84, since in 1967 the median import price was about 16 percent below the domestic [15, pp. 409 - 10]

p_q = domestic price as measured by the BLS wholesale price index for steel mill products

H = measure of temporary hedge demand.

This regression suggests that imported and domestic steel are fairly substitutable, even in the short run. The elasticity of substitution after one year is about unity. The long-run elasticity of substitution is much higher, about 6, since only 17 percent of the adjustment takes place in the first year.

The demand for steel as a whole. The demand for steel as a whole expresses the steel input index s as a function of the steel price index p_s, the price of output p_y, and output in steel-using commodities y. The variables s and p_s are derived using the assumed CES production function for steel-using commodities.

The composite price index is formed from the relation

$$d \ln p_s = v_m d \ln p_m + (1 - v_m) d \ln p_q .$$

where v_m is the import value share. The resulting measure of p_s is expressed as an index, base 1967. The variable s is formed by the relation

$$s = \left\{ c_1 q^{\beta} + c_2 m^{\beta} \right\}^{1/\beta}.$$

Estimates of c_1, c_2, and β are taken from the steady-state form of equation (1).

The aggregation formulas for p_s and s are both based on long-run equilibrium conditions. Hence, they are justified only asymptotically, as the system approaches long-run equilibrium.

The estimates are based on a longer series than used earlier to provide needed variation in the price ratio. Because of the maintained hypothesis of constant returns to scale, the coefficients on output in steel-using industries and the coefficient on lagged steel shipments were constrained to sum to unity.

Equation 4: The Demand for Steel as a Whole—Annual Data 1948–73 (t values in parentheses)

$$\ln(s) = \underset{(14.44)}{14.44} - \underset{(-3.63)}{0.446} \ln\left(\frac{p_s}{p_y}\right) + \underset{(14.50)}{1.294} \ln(y)$$

$$-0.294 \ln(s_{-1}) - \underset{(-6.00)}{0.018t}.$$

R^2 (on transformed data) = 0.955
N = 26
d.f. = 22
D-W = 1.92
ρ = 0.045,

where

- s = composite steel index
- p_s = composite price of steel
- p_y = price of steel using output, measured here by the overall BLS wholesale price index
- y = index of output in steel-using commodities. This is constructed as a weighted average of *Federal Reserve Board* indices of production in the auto, business equipment, and intermediate construction materials industries. Weights are based on relative steel shipments to these sources
- t = time trend.

The supply price of domestic steel. The estimated domestic supply curve is presented below as equation (5). A capacity utilization term was tried, but had little effect on the predictive power of the equation. To represent a maintained hypothesis of complete pass-through of cost in the long run, the coefficients on the lagged price and on the cost variable were constrained to sum to unity. Unconstrained results were similar.

Equation 5: The Supply Price of Domestic Steel — OLS — Annual Data 1948–73 (t values in parentheses)

$$\ln(p_q) = 0.0053 + \underset{(0.738)}{0.374} \ln(w) + \underset{(13.0)}{0.626} \ln(p_q)_{-1}.$$

R^2 (on transformed data) = 0.99
N = 26
d.f. = 24
D-W = 1.61
ρ = 0.440.

The supply price of imports. The supply price of imports, like the domestic supply price, was originally expressed as a function of market conditions and costs. In addition, a measure of technical change, the percentage of foreign production using the advanced basic oxygen process, turned out to be important. To represent the effect of the quota, separate dummy variables were entered for the years 1969–72. A 1973 dummy was insignificant, indicating that the import quota was not binding in the tight 1973 market.

The cost measure employed was a weighted average of prices for individual steel-making materials in Germany and Japan. A steel wage index did not add significantly to the explanatory power of the equation, suggesting that foreign steel is priced according to marginal cost and that there is a disinclination to vary employment.

Market conditions were represented in two alternative ways, by the level of imports to the United States, and by world capacity utilization. The former was dropped because of low explanatory power. This means that the United States does not seem to possess important monopsony power in the market for imported steel.

The regression results are presented in equation (6).

Equation 6: The Supply Price of Exported Foreign Steel — Annual Data 1956–73 (*t* values in parentheses)

$$\ln(p_f) = \underset{(0.409)}{0.135} + \underset{(3.63)}{1.84}\ln(uw) + \underset{(2.19)}{1.10}\ln(wf)$$
$$- \underset{(1.48)}{1.09}\, bf + \underset{(1.22)}{0.089}\, t + \underset{(3.05)}{0.213}\, d_{69}$$
$$+ \underset{(2.67)}{0.205}\, d_{70} + \underset{(2.46)}{0.276}\, d_{71} + \underset{(1.52)}{0.194}\, d_{72}.$$

R^2 (on transformed data) = 0.908
N = 18
d.f. = 9
D-W = 1.66
ρ = 0.804,

where

p_f	= index of the foreign export price in foreign currency units deflated by the foreign wholesale price index
uw	= world capacity utilization
wf	= index of deflated Japanese and German materials prices
bf	= fraction of European and Japanese steel made using the basic oxygen process
t	= time trend
d_{69}–d_{72}	= dummy variables indicating separate years in the period 1969 to 1972.

The positive coefficients on the dummies indicate that the quota had a sharp effect on supply price in these years. Its tariff equivalent seems to be about 20 percent. This helps explain the recent propensity to use quotas, since a tariff of this size would certainly be difficult to obtain.

Appendix B

Techniques Used to Estimate Gains and Losses to Particular Groups

This appendix discusses the conversion of output, price and employment changes into measures of gains and losses. The traditional method of calculating the net gain or loss makes use of consumer surplus, which has always been the source of controversy among economists. The original definition of consumer surplus was the area under the demand curve. This particular measure is often replaced by one based on an income compensated demand curve. The original uncompensated measure is used in this study for several reasons.

First, the income compensated measure requires information not available from our model, namely the demand for each final product using steel. Second, part of the gain from a fall in steel prices is to producers of steel-using goods. It is not clear what type of compensation, if any, is appropriate for these rents. Third, the compensated and uncompensated measures are likely to be close to one another when the level of expenditure on the good is small or when price changes are small. Imported steel, where a significant price change is predicted, is less than one-fifth of 1 percent of GNP.

The Traditional Analysis of Gains and Losses Due to Free Trade

The traditional analysis of consumer gains and losses is from Corden [6]. The analysis assumes that imported and domestic goods are perfect substitutes (an assumption that seems roughly consistent with our results for the long run but not for the short run).

The Corden method treats the demand for imports as the excess demand for the commodity. The supply curve for the domestic product is used to measure the marginal cost of domestic production. For a good description, see [12].

The Modified Version of the Corden Analysis

For use in describing the steel market, we modified the Corden analysis to take into account the following features of the steel market:

- Imported and domestic steel seem to be imperfect substitutes, especially in the short run.
- The price of domestic steel does not seem to fall when demand is slack. This takes place despite an upward-sloping marginal cost curve based on different vintages of capital. Hence, the supply and marginal cost curves seem to differ.
- Because of uncertainty about the permanence of any demand change, steel producing firms do not adjust their work force completely to a drop in demand. There is a cost to them of hoarding the labor when adjusting to free trade.

The modified analysis treats imports and domestic production as imperfect substitutes. Hence, two diagrams are needed, one for imports and one for domestic production.

Figure B-1 represents the import market. When a tariff of T and a tonnage quota of m_1 is in effect, tariff revenues are equal to area X and the quota rent received by foreign producers is XI. When import restrictions are

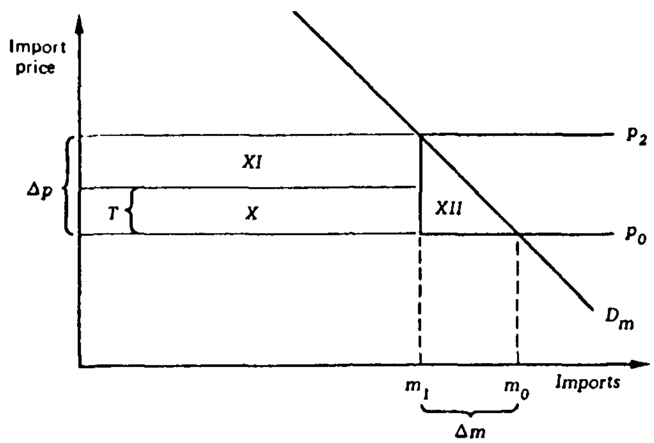

Figure B–1
The Gains to Trade in the Import Market

removed, imports rise from m_1 to m_0, and import price falls from p_2 to p_0. The gain to import users is area X + XI + XII. Of this, there is a loss of area X in tariff revenue.

The domestic steel market is described in Figure B-2. The demand for domestic steel is represented by D_1 when trade restrictions are in effect. Domestic price is p_3, which we assume is just equal to full capacity long-run marginal cost $LRMC$. (This assumption is equivalent to defining capacity as including all vintages of equipment that would be profitable to use at this price.) For expositional convenience, we also assume that, in the presence of trade restrictions, domestic production is at full capacity. This assumption is relaxed in actual calculations.

Short-run marginal cost is represented as $SRMC$. The difference between this and long-run marginal cost is the cost of temporarily hoarding labor while assessing the permanence of a drop in demand.

We now turn to the welfare effects of free trade on the domestic steel market. When trade restrictions are removed and the import price falls, the demand for domestic steel shifts inward. Because of the lack of historical responsiveness of the domestic price to market conditions, we assume that import penetration does not lower the domestic steel price. Domestic output falls from q_2 to q_0.

Since the domestic steel price does not fall, consumers of domestic steel do not receive a gain. On the other hand, there is some loss to producers. The loss of long-run profits is shown by the area above the long-run marginal cost curve, areas $XIII$ and XIV. In addition, there is a further short-run loss in profits due to the cost of hoarded labor. This is represented by area XV + XVI.

There is also another cost, not shown. This is the loss of earnings to displaced workers. It should be emphasized that these adjustment costs, losses of profits and earnings, are a net loss only because the domestic price does not fall. If the price always equaled the marginal opportunity cost of labor and capital (as it would under competitive assumptions), then the domestic price would fall when demand was slack. Any losses to capital and labor would be offset by a corresponding gain to consumers of domestic steel.

Algebraic Formulae for Estimating Gains and Losses

The areas that represent gains and losses from free trade need to be expressed in algebraic form to allow

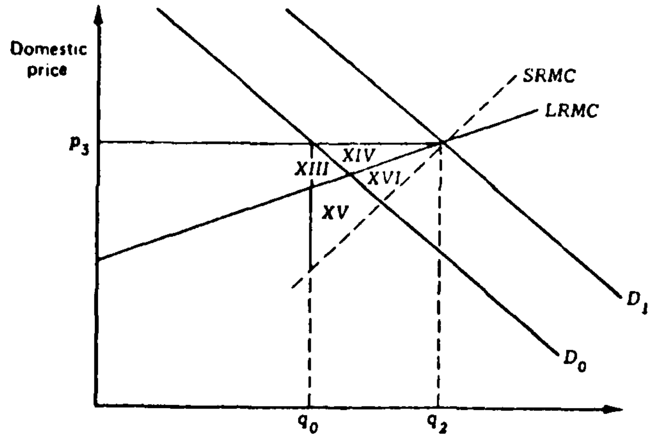

Figure B-2
The Effect of Free Trade on the Domestic Market

numerical estimates of gains and losses to particular groups.

Gains to consumers, shown as areas $X + XI + XII$ in Figure B-1, are approximately equal to the following:

$$\text{consumer gain} = \Delta p \left[m_1 + \frac{\Delta m}{2}\right]$$

$$= \%\Delta p \left[1 + \frac{\%\Delta m}{2}\right] RM,$$

where

- Δp = absolute value of the change in the landed import price due to free trade
- Δm = change in the import quantity
- $\%\Delta p$ = change in the landed price of imports as a percentage of the price with trade restrictions
- $\%m$ = increase in import quantity as a percentage of the import quantity with trade restrictions
- RM = import revenue including tariff and transport. This is estimated from published import revenue in the foreign port adjusted by our estimates of tariff and transport.

The loss of tariff revenue that would accompany free trade is estimated as the product of the value of imports in the foreign port multiplied by the percentage equivalent of the tariff.

The loss of industry profits is based on the long-run marginal cost. This is shown as areas $XIII + XIV$ in Figure B-2. This area is approximately equal to

$$\text{profit loss} = \frac{\Delta LRMC[\Delta q]}{2},$$

where $\Delta LRMC$ is the drop in marginal cost from lower output due to free trade and Δq is the drop in domestic shipments.

In practice, a modified version of this formula was used to reflect the fact that the industry would not have been operating at full capacity, even when trade restrictions are in effect. Hence, part of the profit loss, measured from full capacity, would occur in any case. The new area representing profit loss is shown as the shaded area in Figure B-3.

In Figure B-3, q_c is full capacity shipments, q_2 is shipments with trade restrictions, and q_0 shipments with free trade. The shaded area can be evaluated as

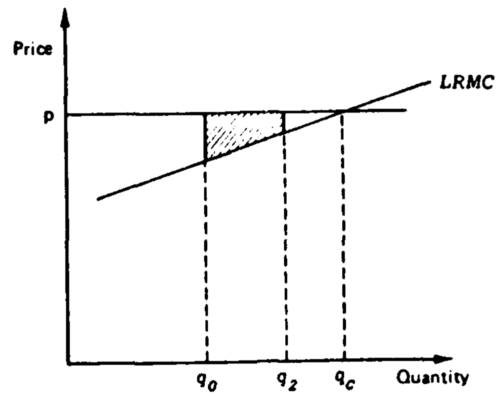

Figure B–3
Losses of Profits for Domestic Firms

$$\text{loss to producers} = \bar{\Delta}LRMC \cdot \Delta q,$$

where $\bar{\Delta}LRMC$ is marginal cost evaluated at full capacity minus marginal cost evaluated at the average of output with and without free trade and Δq is the absolute value of the change in shipments due to free trade.

In percentage change form, the loss to producers is evaluated as

$$\text{loss to producers} = \%\bar{\Delta}LRMC\ \%\Delta q \cdot LRMC_c \cdot q_1$$
$$= \%\bar{\Delta}LRMC\ \%\Delta q \cdot R,$$

where

- $\%\bar{\Delta}LRMC$ = $\bar{\Delta}LRMC$ as a percentage of full capacity marginal cost
- $\%\Delta q$ = (absolute value of the) reduction in domestic shipments expressed as a percentage of shipments with trade restrictions
- q_1 = domestic shipments in the presence of trade restrictions
- $LRMC_c$ = long-run marginal cost evaluated at full capacity
- R = value of domestic shipments in the presence of trade restrictions.

We have used the assumption that full capacity long-run marginal cost is equal to the prevailing price. This allows us to substitute price for marginal cost and then substitute revenue for price times shipments.

Deviations in shipments from capacity are calculated by converting rated capacity, measured in tons of production, to tons of shipments. Since production seldom goes above 97 percent of rated capacity, even when demand is heavy, we took 97 percent of rated capacity as actual capacity.

The calculation of the change in marginal cost was based on Katz's research on vintage capital [11]. He found that the elasticity of labor requirements with respect to output was approximately 2. We assumed that other inputs (which we term materials) for marginal plants varied proportionally with output and that both labor and materials had fixed prices. The elasticity of industry cost with respect to output is a weighted average of the elasticity for individual inputs with weights equal to (industry average) factor shares. Using a labor share of 0.38, an elasticity of labor costs of 2, and an elasticity of other costs of 1, the elasticity of total costs with respect to output is 1.38. (The labor share for the year 1971 is taken from [3, p. 13]). If this elasticity is

taken as roughly constant when output contracts, the elasticity of marginal cost with respect to output is 0.38. Hence, the percentage change in marginal cost is

$$\%\bar{\Delta}LRMC = \%\bar{\Delta}q \cdot 0.38,$$

where $\%\bar{\Delta}q$ is shipments at full capacity minus the average of shipments with and without trade restrictions. The difference is expressed as a percentage of shipments at full capacity.

The preceding discussion describes a loss of rent to the industry based on the long-run vintage marginal cost curve. In addition, there is a loss due to labor hoarding.

We estimate the quantity of labor hoarded in several steps. The first is to derive desired employment. We take observed annual employment in 1969–73 as a measure of desired employment in the presence of trade restrictions. To derive desired employment without trade restrictions, we adjust these employment figures by the percentage effect of free trade on employment. We use Katz's estimate that the percentage effect on desired employment is twice the output change.

Once the free trade employment figures are derived, they are used to estimate free trade labor hoarding. We assume that, if employment drops between year 0 and year 1, one-half the desired employment reduction is made, the rest being hoarded. If demand drops farther in year 2, the year 1 hoardees are laid off and one-half of the remaining employment decline is made, the remainder being hoarded. (If desired employment had risen sufficiently in year 2, none of the year 1 hoardees would have been laid off.)

These assumptions are used to estimate hoarding in the free trade situation. The cost of hoarding to the industry is the number of workers hoarded multiplied by employment costs per worker, the latter from [3].

The remaining loss from free trade is the earnings loss to workers. The calculation of earnings losses begins with the estimation of layoffs, with and without free trade. Layoffs are the change in employment (after accounting for labor hoarding) minus the amount that can be handled by attrition. We assume that attrition is equal to 1.5 percent of the previous year's labor force.

From layoffs with and without free trade, we estimate the change in layoffs due to free trade. This change is multiplied by Jacobson's estimate of loss in lifetime earnings per laid-off worker to obtain total earnings losses.

In this appendix we have described the calculation of gains and losses to specific groups. The losses are calculated for each group and for each year between 1969 and 1973. These annual figures are then converted to present values as described in the text.

Literature Cited

1. Adams, Walter, and Joel Dirlam. "Steel Imports and Vertical Oligopoly Power." *American Economic Review*, 54 (September 1964), 626-55.
2. ________. "Big Steel, Invention and Innovation." *The Quarterly Journal of Economics*, 80 (May 1966), 167-89.
3. *Annual Statistical Report, American Iron and Steel Institute, 1973*. Washington, D.C., 1974.
4. Armington, Paul S. "A Theory of Demand for Products Distinguished by Place of Production." *IMF Staff Papers* (March 1969), 159-76.
5. *Chartering Annual*. New York: Maritime Research, Inc. Various issues.
6. Corden, W. M. "The Calculation of the Cost of Protection." *Economic Record*, 33 (April 1957) 29-51.
7. Floyd, John E. "The Effects of United States Trade Restrictions on Economic Efficiency." Manuscript prepared for the Department of Labor (ILAB), 1974.
8. ________. "*The Overvaluation of the Dollar: A Note on* the International Price Mechanism." *American Economic Review*, 55 (March 1965), 95-106.
9. Jacobson, Louis. *Earnings Loss of Workers Displaced from the Steel Industry by Imports of Steel* (PRI 197-75). Arlington, Va.: Public Research Institute, 1975.
10. *Highlights of U.S. Export and Import Trade, August 1974*, U.S. Department of Commerce (FT 990).
11. Katz, Arnold. "Estimates of Labor Displacement: A Structural Approach." *Removing Restrictions on Imports of Steel*, edited by James Jondrow et al., pp. 4-1 to 4-50. PRI 75-2. Arlington, Va.: Public Research Institute.
12. Magee, Stephen. "The Welfare Effects of Restrictions on U.S. Trade." *Brookings Papers on Economic Activity*, No. 3 (1972), 645-701.
13. Stigler, George, and James Kindahl. *The Behavior of Industrial Prices*. New York City: National Bureau of Economic Research, 1970.
14. Thorn, Richard S. "Steel Imports, Labor Productivity and Cost Competitiveness." *Western Economic Journal* (December 1968), 375-84.
15. U.S. Senate, Committee on Finance, Staff Study, 90th Congress, 2d session, *Steel Imports*, 1968.
16. "U.S. Steel Cuts Prices to Fight Import Boom, Dismaying Other Mills." *Wall Street Journal*, May 19, 1968, p. 1.

Comment

Edmund Ayoub

I find much to agree and to disagree with in Mr. Jondrow's study. His time-frame (1969–73) allows him a little complacency about steel import penetration and our ability to adjust to its "gradualness." The facts show a decline in import penetration from 1969 to 1973. However, the peak penetration rate in 1971 was nearly quadruple what it was in 1960. Under some circumstances one might consider import penetration growth from 4.7 percent to 17.9 percent in eleven years as reasonably easily adjusted to. But the adverse job impact of steel import penetration compounded the problem of the secular decline in employment caused by such factors as technological developments and the U.S. industry's significantly declining share of the world market. All told, the job impact takes on a magnitude that justifies our concern about the steel import problem.

Though neither appears to be on the horizon, two developments could mitigate our concern: the achievement and maintenance of a full employment economy, and a strengthening of "fair" trade in world steel.

The author of this paper seeks to determine what the effect of free trade would have been during the 1969–73 period, had we not had the restraints of tariffs and the Voluntary Restraint Agreement (VRA). Briefly, I believe that the period of the investigation is too narrow to allow sufficient perspective on the problem of steel imports. This results in a distortion of the impact of free trade on the U.S. steel industry.

The structure of world steel trade has changed in the post-World War II period. In most countries, steel was an industry that produced mainly for domestic consumption. The postwar rebuilding of new, efficient industries abroad soon resulted in the surfeit of domestic supply in other countries, part of which was exported to the U.S. market. The U.S. share of the world market continued to decline long after the rehabilitation period abroad, when decline was expected and inevitable. Restrictive practices of U.S. trading partners that were established during this rebuilding period have hung on, and now constitute an unfair advantage in trade to the U.S. industry. In other words, the United States might well have a natural comparative advantage in producing steel, but foreign subsidies and trade restrictions have prevented it from being exploited in world trade. In such a situation it is not at all clear that "free trade" in steel is in the U.S. national interest, let alone that of the industry.

Jondrow identifies his time-frame (1969–73) as the period between import penetration (the 1960s) and the period of "reduced threat from imports" (after 1973). Perhaps he is right for the former period, but it is not clear that he is right for the latter period. For one thing, the decline of import penetration since 1973 resulted largely from an "institutional" factor in collective bargaining—the Experimental Negotiating Agreement (ENA). The ENA prevented an industry-wide strike over economic issues, thus communicating to steel-consuming industries that stockpiling was unnecessary. ENA effectively altered the buying behavior of consuming industries. Without ENA, we would surely have had another surge of imports accompanying the 1974 steel negotiations. However, imports rose only moderately, reflecting domestic shortages of particular products and some apprehension over a possible coal strike in late 1974. Thus, by limiting the period of study the author has denied himself a sufficient length of time for an appropriate perspective on the import problem; and he has omitted an important causal factor in the question of import penetration that a broader time-frame would have provided.

There are two cycles in steel that affect output and employment—the "economic cycle" and the "negotiating cycle." They overlap, but their separate effects can be identified, particularly with respect to the initial phases of each. The initial phase of the "negotiating cycle" is particularly pertinent to imports. Jondrow acknowledges the effect of contract negotiations on import penetration. However, it is not treated systematically as a substantive factor in the causal relationship. The data suggest otherwise. They show that import penetration peaked in negotiating years. And the peaks were higher in each successive negotiating year of the 1960s and in 1971—the last negotiating year preceding ENA. The surge of steel buying abroad was most pronounced in the eight to nine months preceding contract termination. This was followed by a sharp drop in output and employment after the contract termination date as inventories were worked off. During the interim years between negotiations, steel imports were sustained at relatively high levels because of consuming industries' familiarity with import purchasing, and long term contract requirements with foreign suppliers to protect steel buyers from short supplies during the next presettlement cycle. This cyclical pattern did not occur in the 1974 negotiations under ENA.

I do not mean to suggest that import/domestic price

differential is not a factor; but it is not a sufficiently complete explanation. It may suggest that steel import purchasing, under certain conditions, is not as price sensitive as one might think a priori. Steel-consuming industries that chose to stockpile in the early stages of the negotiating cycle prior to the 1974 negotiations would probably have purchased imports even without an appropriate price differential. That is a hypothesis that would warrant investigation, by studying price differentials during the high import periods preceding 1965, 1968, and 1971 steel negotiations.

I wish to take exception to another one of the author's assumptions. The Voluntary Restraint Agreement (VRA) is assumed by Jondrow to have restrained trade during most of the period 1969–73. (VRA was in effect for the period 1969–74.) I think that the reverse was true. Without the "restraint" of the quota, less steel probably would have entered our market. VRA provided for an annual quota increase of 5 percent, which is double the average long-run rate of increase in steel demand in the United States. Foreign steel producers sought to garner their quota shares despite shortages of steel in their own countries during part of this period. The long-run benefits of establishing a larger base in the world's largest market are obvious. Without the encouragement of the VRA, the foreign producers might well have supplied their own domestic needs more fully, and the U.S. market might have been spared the alleged benefits of VRA "protection." Voluntary restraint agreements can be useful on a temporary basis for circumventing market disruption; but without a built-in penetration factor.

Is the U.S. industry's period of vulnerability to import penetration over? Jondrow seems to suggest that it is. The time-frame for this study coincided with what he believed to be the peak period of import penetration, at least for several years ahead. Alternatively I have suggested that the ENA played a decisive role in limiting further penetration in the period after 1973.

Market penetration is an important goal of foreign steel producers; once they achieve it, they tend to hang on. Price differentials are a mechanism for penetration. Thus, even if rapidly rising cost factors are working against the comparative advantage of foreign steel producers, I am not fully satisfied that penetration would stabilize or decline. The recent agreement between the EEC and Japan to reduce the latter's exports to the European market has shifted those exports to the U.S. market. Japanese imports rose two million tons in 1976, representing nearly 56 percent of total imports. Moreover, European producers have expressed a desire to restrict steel shipments with one another, while maintaining output levels in the individual countries. If successful, we can expect a rise in European imports of steel to the United States, probably by means of dumping.[1]

The rising level and proportion of imports into the United States over the past decade and a half have cost the steel industry dearly in jobs. A methodology based upon uncertain assumptions and questionable data which leads to conclusions about job loss and the ability to absorb such losses is one I find difficult to accept. We have lost tens of thousands of steel jobs to imports. The loss of income to individual employees is great. In an article published in this volume, Louis Jacobson estimates an earnings loss for displaced steelworkers over a six-year period of about 24 percent, with an average loss for the first two years of over 46 percent. Many cities in this country are largely dependent upon steel for employment. Therefore, entire communities are adversely affected when steel jobs are lost. The tax base deteriorates, retail establishments suffer, and the entire infrastructure of the community is threatened. Adjustments to job losses of such pervasive influence take a long time and are very costly.

The author makes a case for trade liberalization. The effort in these comments is not to argue against trade liberalization. It is to suggest that trade must be a two-way street to be effective; and it must assure reasonable stability in world markets. That foreign imports did not "take over" the U.S. market during the industry's "long period of vulnerability" is no assurance that growing import penetration could not resume and do further damage to U.S. markets and jobs. The least we should be able to expect is a safeguard against market disruption, and some corresponding effort by foreign producers to eliminate trade restrictions in their own markets.

We are faced with a problem of growing national concern. It is inadvisable to allow excessive deterioration of our steel base in this country through further import penetration. We will, at some point, jeopardize national security interests in excessive import displacement of domestic steel production. Steel shortages are expected in the 1980s. If high import penetration discourages sufficient capital investment in new capacity, we could well find ourselves unable to supply our own domestic needs fully. The skilled labor supply that is now being lost because of high imports could well become another bottleneck to expansion later on. These are matters that must also be addressed in evaluating the impact of steel trade in the U.S. market.

---

[1] This paper was written in January 1977. The annual rate of EEC imports, based on the first seven months of 1977, amounted to 4.8 million tons, or 49.2 percent above full-year 1976 imports.

Mr. Jondrow has made an effective contribution to the study of trade liberalization in steel; but we must be cautious about drawing premature conclusions about policy implications. A much broader perspective on the issues is essential at this stage.

Comment

Hendrik S. Houthakker

The following comments on the paper by Jondrow et al. deal mostly with chapter 3 on the econometric model. This chapter is of particular interest not only because of its central position in the study and its generally high quality, but also because of the analytical and policy issues it raises. Since many of my comments will inevitably be critical, let me preface them by expressing broad *agreement* with the approach taken in the study and with the methods by which they were derived. More specifically I endorse the principal finding that removal of steel import restrictions would not lead to a significant decline in domestic employment and that the benefits to the public at large from such removal would outweigh the losses. Indeed I shall argue that the study did not go far enough in identifying the benefits of free trade in steel to the U.S. economy.

The basic model formulated in the beginning of chapter 3 presents no great problems, though disaggregation with respect to product classes or steel-consuming industries might have added to its usefulness (and, to be sure, to the difficulty of estimating it). The first major questions arise on pages 3–9, where it is stated without further explanation that "The estimates are constructed using annual data (1956–73). Equations were also estimated based on quarterly data (1964–1973. II), but they were much less satisfactory and hence are not reported."

Why did not the annual data cover a longer period? Some of the graphs indicate that earlier data were available; since no list of data sources is included, it is difficult to check further into this question. It is important because an adequate number of observations is essential to confidence in any econometric exercise. Considering the large number of variables that have to be considered, eighteen or nineteen observations are decidedly skimpy.

It would also have been illuminating to know more about the problems with quarterly data (and why they were available for less than ten years). Did the quarterly results contradict the underlying economic theory, or were too many estimates statistically insignificant? The author may well have been correct in concentrating on

the annual results, but if quarterly data gave a different picture the reader should be told.

Although the analysis of substitution between home-produced and imported steel is competently done, further insight could have been provided by looking at the composition of imports by product classes, which was rather different from the composition of domestic output. Import penetration was greatest in simple products such as reinforcing bars, while the domestic industry, at least until the imposition of quotas, was not seriously threatened in such bread-and-butter products as cold-rolled sheet. The estimated elasticity of substitution between imports and home products may in large part reflect substitution among different product classes, whether on the supply side or on the demand side.

The overall demand equation for steel is much less convincing than the substitution equation. It is not clear that Q as defined by Jondrow is a sufficiently comprehensive measure of activity in steel-consuming industries; where do cans and electric appliances come in, for instance? Moreover one wonders whether Q is really exogenous, considering that it is affected by imports of steel-intensive products such as automobiles. It is also difficult to believe that nonferrous metals are the major substitute for steel, to the extent (assumed in the equation on p. 3 - 28) that a change in nonferrous prices would have as much impact on steel consumption as an equal percentage change in steel prices. In this equation the elasticity estimate is not very significant and a trend term with a surprisingly large negative coefficient does nearly all the work, casting doubt on the assumption that the coefficient of ln Q is unity.

With the short-term supply equation (More precisely, the price equation) we come to the crux of the steel industry's problems. Steel executives have long been emphatic in their rejection of price competition as inappropriate for industrial materials. Except for the regulated sector, there is probably no major industry where prices are less responsive to demand fluctuations than in steel, though some discounting from list prices occurs intermittently. This inflexibility of steel prices, to which I shall return below, is confirmed by Jondrow's analysis where the coefficient of capacity utilization is small and barely in excess of its standard error.

In other respects, however, the discussion of short-term price determination leaves something to be desired. The observed leveling-off of steel prices in the 1960s may indeed have been due to imports, but could also have reflected President Kennedy's 1962 intervention and later jawboning by the Council of Economic Advisers, for which steel was the principal target. Furthermore the early and middle 1960s were a period of relative price stability generally. No reference is made to the extensive literature on industrial price equations with its stress on labor productivity (output per manhour); this factor is not adequately captured by the basic-oxygen penetration ratio used by Jondrow as a proxy for technological change. As is true in the other equations, a more precise definition of the variables and their relations to the data would have been in order.

The author makes only modest claims for the remaining two equations of his model, those for domestic capacity and foreign supply, and his modesty is justified. Both the published equations are the result of a long process of trial and error that is not described in any detail. Apparently the capacity problem was approached through the accelerator rather than through profits; again the literature on investment functions is not referred to. It is unfortunate that a more satisfactory capacity equation could not be obtained, for the development of steel capacity is a major puzzle. Since the 1950s only one major new mill has been built in the United States, and none are under construction at present. Many of the existing mills are now obsolete by international standards (and often also by environmental standards), and this may well be the main reason for our steel industry's vulnerability to imports. As far as one can tell, capacity has actually been declining despite some investment in the modernization and expansion of existing plants.

The foreign supply (or export price) equation features a large number of parameters (nine, with only eighteen observations) but even so does not fit the data very closely. Some of these variables could advantageously have been omitted or combined. The most interesting conclusion from this equation is "the strong effect of world demand on the export price," illustrating the radical difference in price flexibility between the world market and the U.S. market. It is also estimated that in 1969 - 72 the export quotas held imports into the United States down by about 20 percent, a plausible figure that makes one wonder why the quota scheme was pursued with such vigor; surely our market could have absorbed a few million additional tons without seriously affecting the domestic industry.

Notwithstanding the defects of particular equations, the model of Chapter 3 is acceptable as a first approximation: the whole is better than the parts. I shall not comment on the projections for 1974 - 78, since the assumptions on which they are based appear to have been unrealistic; apparently the macroeconomic forecasts used for this purpose did not anticipate the severity of the 1974 - 75 recession. In 1975, for instance, domestic shipments were only 80 million tons compared to the projected 102 million tons, and imports were also well below the projections. An updating of these projections would clearly be desirable.

Space does not permit detailed comment on the other chapters. In chapter 4 of the underlying research report that was summarized in Jondrow's paper, Arnold Katz grapples imaginatively, but in the end inconclusively, with the well-known conundrum of increasing returns to labor in the short run. Some of his work on the production function could be integrated into the overall model of chapter 3. The analysis of displacement losses in chapter 5 is extremely detailed and apparently complete; whether it will convince the unions is another matter. Chapter 6, a sophisticated discussion of surplus measurement, is somewhat out of place in this generally down-to-earth study.

Chapter 7 deals mostly with the suitability of basic-oxygen penetration as an indicator of cost differences; not surprisingly it does not come to a definite conclusion. The fact is that there have been important technological changes unrelated to BOF, but these are never mentioned. Examples are continuous casting, which dispenses with the labor-intensive blooming mill, and computerization of rolling mills; the ever-increasing size of blast furnaces and the pretreatment of ores can also have a significant effect on cost. The tendency throughout the report to identify technological change with the basic-oxygen furnace detracts from its usefulness as a contribution to steel industry economics.

In conclusion I return to the question of price flexibility as it is affected by imports. The industry's abhorrence of price competition goes back many years, at least to Judge Elbert Gary (1846–1927) who, frustrated in his plans to turn U.S. Steel into a monopoly, enjoined the successor firms to "live and let live." In effect, the steel industry behaves like a cartel, though this does not necessarily mean that its practices are illegal. (The historical argument for this industry's adherence to full-cost pricing, namely large fixed cost, is incidentally contradicted by the report, which puts variable cost at 87 percent of total cost.)

This harmony among potential rivals was threatened when imports became competitive in the 1950s. The exporters did not belong to the U.S. informal cartel and they were not used to inflexible prices. Although the European and Japanese steel industries are hardly examples of perfect competition, substantial price fluctuations in response to changes in demand do occur. The American industry was concerned not only because of the loss of business, but also because its pricing practices became vulnerable. This is one of the reasons why imports were ultimately controlled by quotas rather than tariffs; import quotas reinforce a domestic cartel, while tariffs (unless prohibitive) encourage price flexibility.

The federal government under Presidents Johnson and Nixon was only too willing to negotiate "voluntary" export quotas, following a pattern already laid down in textiles and meat. Foreign steel industries were prepared to cooperate because export quotas permitted them to charge higher prices in the United States. As far as revenue is concerned, an export quota is equivalent to a duty collected by the exporting industry (not, be it noted, by the exporting country). By making the quota "voluntary," compensation under the General Agreement on Trade and Tariffs rules was avoided.

Were these arrangements in the public interest? Although the voluntary quotas have lapsed, the question is not merely of academic interest, for any future protection given to our steel industry may well be on similar lines. In my opinion the answer is clearly no. Inflexible prices are contrary to economic efficiency both in a microeconomic and a macroeconomic sense. Microeconomically, because cartel-like pricing practices tend to keep inefficient firms in operation; there have been very few bankruptcies in this stagnant industry where the efficient firms have apparently refrained from expansion (especially through new plants) for fear of upsetting the established market pattern. As a result both the profitability and the productivity performance of the steel industry have been below average.

Even more serious is the macroeconomic effect of inflexible prices (more precisely, of prices that are determined primarily by cost and bear little relation to demand conditions). When prices are inflexible, changes in demand are immediately translated into changes in output, and ultimately in employment. Thus if demand in an important industry (such as steel) weakens, its customers are not given any incentive to buy more, especially for inventory. The fall in output and employment brings stimulative fiscal and monetary policies into action, with their attendant inflationary pressures. Inadequate price flexibility in major industries — steel is not an exception, just an extreme case — therefore contributes powerfully to the combined inflation and unemployment that has increasingly plagued us in recent years. Furthermore, the low levels of investment implicit in cartel-like pricing deprive the economy of needed stimulus from the private sector.

The removal of import restrictions on steel, therefore, has an importance well beyond the industry immediately affected. As the report shows, the disruptive effects of such liberalization would be minor in any case. Among its benefits, considerable weight should

be given to the invigorating force of price competition, which could give our steel industry the dynamic role in our economy it had many years ago.[1]

Reply

James M. Jondrow

Though agreeing broadly with the general approach and findings of the study, Professor Houthakker makes a number of specific comments on the estimation of the model.

One is on the limited number of annual observations. This comment is applied specifically to the import supply equation. Though more observations are clearly better than fewer, a large number of observations is not necessary for precision of estimation. Most of the parameters of interest in the model have significant coefficients, even when degrees of freedom are taken into account. A necessity for reliable estimation is variation in the independent variables, and this variation was available for most of our time series. Furthermore, by using a short sample period one avoids some of the difficulties associated with structural change that may affect long-term estimates.

One possibility for increasing the sample size, as Professor Houthakker mentions, is quarterly data. Our sources for quarterly data did not extend back as far as for the annual data. Furthermore, though quarterly data increased the number of observations, there was actually less variation in the independent variables over the shorter number of years and there was apparently random variation in the dependent variables. In the quarterly model, these problems led to imprecise estimates of substitution between domestic and imported steel. Estimates of the elasticity of substitution had high standard errors and were not robust to even minor changes in the specification of the equation. In contrast, results based on annual data over a longer span of years were more precise and robust.

Professor Houthakker finds the demand for steel equation less convincing than the substitution equation. The latter is much more important in evaluating the effect of imports. He questions the use of the nonferrous price as the price of substitute materials in the demand for steel equation. Yet results using the wholesale price index for all commodities as reported in the paper were much the same. This robustness is desirable since there is no obvious best measure of the price of substitutes.

[1] In this connection it is unfortunate that the report has little or nothing to say about steel exports, which have been significant even in some recent years (in 1970 and 1973 exports were about half the size of imports). A less hidebound pricing and investment policy might well make our industry into a sizable exporter of certain products.

His main comment on the short-term price equation is that there are other explanations besides imports for the leveling off of steel prices in the 1960s. We agree. Indeed our empirical work found that the leveling of the steel price during the 1960s could be explained by a leveling of input prices. But other factors might also be involved.

An estimated capacity equation was reported in the research report on which our conference paper was based. The equation turned out to be unimportant, and was dropped. Still, as Professor Houthakker comments, an equation explaining capacity formation would be very useful. We agree. In fact, our findings on the subject seem plausible. Output is a strong determinant of capacity when corrected for cyclical variation and substitution between capacity and other inputs is limited.

CNA Professional Papers – 1976 to Present†

PP 141
Mizrahi, Maurice M., "Generalized Hermite Polynomials,"* 5 pp., Feb 1976 (Reprinted from the Journal of Computational and Applied Mathematics, Vol 1, No 4 (1975), 273-277)
*Research supported by the National Science Foundation

PP 143
Horowitz, Stanley and Sherman, Allan (LCdr., USN), "*Maintenance Personnel Effectiveness in the Navy*," 33 pp., Jan 1976 (Presented at the RAND Conference on Defense Manpower, Feb 1976) AD A021 581

PP 144
Durch, William J., "The Navy of the Republic of China – History, Problems, and Prospects," 66 pp., Aug 1976 (Published in "A Guide to Asiatic Fleets," ed. by Barry M. Blechman and Robert Berman, Naval Institute Press) AD A030 460

PP 145
Kelly, Anne M., "Port Visits and the "Internationalist Mission" of the Soviet Navy," 36 pp., Apr 1976, AD A023 436

PP 147
Kessler, J. Christian, "Legal Issues in Protecting Offshore Structures," 33 pp., Jun 1976 (Prepared under task order N00014-68-A-0091-0023 for ONR) AD A028 389

PP 149
Squires, Michael L., "Counterforce Effectiveness: A Comparison of the Tsipis "K" Measure and a Computer Simulation," 24 pp., Mar 1976 (Presented at the International Study Association Meetings, 27 Feb 1976) AD A022 591

PP 150
Kelly, Anne M. and Petersen, Charles, "Recent Changes in Soviet Naval Policy: Prospects for Arms Limitations in the Mediterranean and Indian Ocean," 28 pp., Apr 1976, AD A 023 723

PP 151
Horowitz, Stanley A., "The Economic Consequences of Political Philosophy," 8 pp., Apr 1976 (Reprinted from Economic Inquiry, Vol. XIV, No 1, Mar 1976)

PP 152
Mizrahi, Maurice M., "On Path Integral Solutions of the Schrodinger Equation, Without Limiting Procedure,"* 10 pp., Apr 1976 (Reprinted from Journal of Mathematical Physics, Vol. 17, No. 4 (Apr 1976), 566-575).
*Research supported by the National Science Foundation

PP 153
Mizrahi, Maurice M., "WKB Expansions by Path Integrals, With Applications to the Anharmonic Oscillator,"* 137 pp., May 1976, AD A025 440
*Research supported by the National Science Foundation

PP 154
Mizrahi, Maurice M., "On the Semi-Classical Expansion in Quantum Mechanics for Arbitrary Hamiltonians," 19 pp., May 1976 (Published in Journal of Mathematical Physics, Vol 18, No 4, pp. 786-790, Apr 1977), AD A025 441

PP 155
Squires, Michael L., "Soviet Foreign Policy and Third World Nations," 26 pp., Jun 1976 (Prepared for *presentation at the Midwest Political Science* Association meetings, Apr 30, 1976) AD A028 388

PP 156
Stallings, William, "Approaches to Chinese Character Recognition," 12 pp., Jun 1976 (Reprinted from Pattern Recognition (Pergamon Press), Vol. 8, pp. 87-98, 1976) AD A028 692

PP 157
Morgan, William F., "Unemployment and the Pentagon Budget: Is There Anything in the Empty Pork Barrel?" 20 pp., Aug 1976 AD A030 455

PP 158
Haskell, LCdr. Richard D. (USN), "Experimental Validation of Probability Predictions," 25 pp., Aug 1976 (Presented at the Military Operations Research Society Meeting, Fall 1976) AD A030 458

PP 159
McConnell, James M., "The Gorshkov Articles, The New Gorshkov Book and Their Relation to Policy," 93 pp., Jul 1976 (Published in Soviet Naval Influence: Domestic and Foreign Dimensions, ed. by M. McCGwire and J. McDonnell; New York; Praeger, 1977) AD A029 227

PP 160
Wilson, Desmond P., Jr., "*The U.S. Sixth Fleet and* the Conventional Defense of Europe," 50 pp., Sep 1976, AD A030 457

PP 161
Melich, Michael E. and Peet, Vice Adm. Ray (USN, Retired), "Fleet Commanders: Afloat or Ashore?" 9 pp., Aug 1976 (Reprinted from U.S. Naval Institute Proceedings, Jun 1976) AD A030 456

PP 162
Friedheim, Robert L., "Parliamentary Diplomacy," 106 pp. Sep 1976 AD A033 306

PP 163
Lockman, Robert F., "A Model for Predicting Recruit Losses," 9 pp., Sep 1976 (Presented at the 84th annual convention of the American Psychological *Association, Washington, D.C.*, 4 Sep 1976) (Published in Defense Manpower Policy (Richard V. L. Cooper, ed.), The Rand Corporation, 1979), AD A030 459

PP 164
Mahoney, Robert B., Jr., "An Assessment of Public and Elite Perceptions in France, The United Kingdom, and the Federal Republic of Germany," 31 pp., Feb 1977 (Presented at Conference "Perception of the U.S. – Soviet Balance and the Political Uses of Military Power" sponsored by Director, Advanced Research Projects Agency, April 1976) AD A036 599

PP 165
Jondrow, James M., "Effects of Trade Restrictions on Imports of Steel," 67 pp., November 1976, (*Delivered at ILAB Conference in Dec 1976*)

PP 166 – Revised
Feldman, Paul, "Why It's Difficult to Change Regulation," Oct 1976, AD A037 682

PP 167
Kleinman, Samuel, "ROTC Service Commitments: a Comment," 4 pp., Nov 1976, (Published in Public Choice, Vol. XXIV, Fall 1976) AD A033 305

PP 168
Lockman, Robert F., "Revalidation of CNA Support Personnel *Selection Measures*," 36 pp., Nov 1976

PP 169
Jacobson, Louis S., "Earnings Losses of Workers Displaced from Manufacturing Industries," 38 pp., Nov 1976, (Delivered at ILAB Conference in Dec 1976), AD A039 809

PP 170
Brechling, Frank P., "A Time Series Analysis of Labor Turnover," Nov 1976. (Delivered at ILAB Conference in Dec 1976)

PP 171
Jordan, A. S.* and Ralston, J. M., "A Diffusion Model for GaP Red LED Degradation," 10 pp., Nov 1976, (Published in Journal of Applied Physics, Vol. 47, pp. 4518-4527, Oct 1976)
*Bell Laboratories

PP 172
Classen, Kathleen P., "Unemployment Insurance and the Length of Unemployment," Dec 1976, (Presented at the University of Rochester Labor Workshop on 16 Nov 1976)

PP 173
Kleinman, Samuel D., "*A Note on Racial Differences* in the Added-Worker/Discouraged-Worker Controversy," 2 pp., Dec 1976, (Published in the American Economist, Vol. XX, No. 1, Spring 1976)

PP 174
Mahoney, Robert B., Jr., "A Comparison of the Brookings and International Incidents Projects," 12 pp. Feb 1977 AD A037 206

PP 175
Levine, Daniel; Stoloff, Peter and Spruill, Nancy, "Public Drug Treatment and Addict Crime," June 1976, (Published in Journal of Legal Studies, Vol. 5, No. 2)

PP 176
Felix, Wendi, "Correlates of Retention and Promotion for USNA Graduates," 38 pp., Mar 1977, AD A039 040

PP 177
Lockman, Robert F. and Warner, John T., "Predicting Attrition: A Test of Alternative Approaches," 33 pp. Mar 1977 (Presented at the OSD/ONR Conference on Enlisted Attrition, Xerox International Training Center, Leesburg, Virginia, 4-7 April 1977), AD A039 047

PP 178
Kleinman, Samuel D., "An Evaluation of Navy Unrestricted Line Officer Accession Programs," 23 pp. April 1977, (Presented at the NATO Conference on Manpower Planning and Organization Design, Stresa, Italy, 20 June 1977), AD A039 048

†CNA Professional Papers with an AD number may be obtained from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22151. Other papers are available from the Management Information Office, Center for Naval Analyses, 2000 North Beauregard Street, Alexandria, Virginia 22311. An Index of Selected Publications is also available on request. The index includes a Listing of Professional Papers; with abstracts; issued from 1969 to June 1980.

PP 179
Stoloff, Peter H. and Balut, Stephen J., "Vacate: A Model for Personnel Inventory Planning Under Changing Management Policy," 14 pp. April 1977, (Presented at the NATO Conference on Manpower Planning and Organization Design, Stresa, Italy, 20 June 1977), AD A039 049

PP 180
Horowitz, Stanley A. and Sherman, Allan. "The Characteristics of Naval Personnel and Personnel Performance," 16 pp. April 1977, (Presented at the NATO Conference on Manpower Planning and Organization Design, Stresa, Italy, 20 June 1977). AD A039 050

PP 181
Balut, Stephen J. and Stoloff, Peter, "An Inventory Planning Model for Navy Enlisted Personnel," 35 pp., May 1977 (Prepared for presentation at the Joint National Meeting of the Operations Research Society of America and The Institute for Management Science. 9 May 1977, San Francisco, California), AD A042 221

PP 182
Murray, Russell, 2nd, "The Quest for the Perfect Study or My First 1138 Days at CNA," 57 pp., April 1977

PP 183
Kassing, David, "Changes in Soviet Naval Forces," 33 pp., November, 1976, (Published as part of Chapter 3, "General Purpose Forces: Navy and Marine Corps," in Arms, Men, and Military Budgets, Francis P. Hoeber and William Schneider, Jr. (eds.), (Crane, Russak & Company, Inc.: New York), 1977), AD A040 106

PP 184
Lockman, Robert F., "An Overview of the OSD/ONR Conference on First Term Enlisted Attrition," 22 pp., June 1977, (Presented to the 39th MORS Working Group on Manpower and Personnel Planning, Annapolis, Md., 28-30 Jun 1977), AD A043 618

PP 185
Kassing, David, "New Technology and Naval Forces in the South Atlantic," 22 pp. (This paper was the basis for a presentation made at the Institute for Foreign Policy Analyses, Cambridge, Mass., 28 April 1977), AD A043 619

PP 186
Mizrahi, Maurice M., "Phase Space Integrals, Without Limiting Procedure," 31 pp., May 1977, (Invited paper presented at the 1977 NATO Institute on Path Integrals and Their Application in Quantum Statistical, and Solid State Physics, Antwerp, Belgium, July 17-30, 1977) (Published in Journal of Mathematical Physics 19(1), pp. 298-307, Jan 1978), AD A040 107

PP 187
Coile, Russell C., "Nomography for Operations Research," 35 pp., April 1977 (Presented at the Joint National Meeting of the Operations Research Society of America and The Institute for Management Services, San Francisco, California, 9 May 1977), AD A043 620

PP 188
Durch, William J., "Information Processing and Outcome Forecasting for Multilateral Negotiations: Testing One Approach," 53 pp., May 1977 (Prepared for presentation to the 18th Annual Convention of the International Studies Association, Chase-Park Plaza Hotel, St. Louis, Missouri, March 16-20, 1977), AD A042 222

PP 189
Coile, Russell C., "Error Detection in Computerized Information Retrieval Data Bases," July, 1977, 13 pp. (Presented at the Sixth Cranfield International Conference on Mechanized Information Storage and Retrieval Systems, Cranfield Institute of Technology, Cranfield, Bedford, England, 26-29 July 1977), AD A043 580

PP 190
Mahoney, Robert B., Jr., "European Perceptions and East-West Competition," 96 pp., July 1977 (Prepared for presentation at the annual meeting of the International Studies Association, St. Louis, Mo., March, 1977), AD A043 661

PP 191
Sawyer, Ronald, "The Independent Field Assignment: One Man's View," August 1977, 25 pp.

PP 192
Holen, Arlene, "Effects of Unemployment Insurance Entitlement on Duration and Job Search Outcome," August 1977, 6 pp., (Reprinted from Industrial and Labor Relations Review, Vol., 30, No. 4, Jul 1977)

PP 193
Horowitz, Stanley A., "A Model of Unemployment Insurance and the Work Test," August 1977, 7 pp. (Reprinted from Industrial and Labor Relations Review, Vol. 30, No. 40, Jul 1977)

PP 194
Classen, Kathleen P., "The Effects of Unemployment Insurance on the Duration of Unemployment and Subsequent Earnings," August 1977, 7 pp. (Reprinted from Industrial and Labor Relations Review, Vol. 30, No. 40, Jul 1977)

PP 195
Brechling, Frank, "Unemployment Insurance Taxes and Labor Turnover: Summary of Theoretical Findings," 12 pp. (Reprinted from Industrial and Labor Relations Review, Vol. 30, No. 40, Jul 1977)

PP 196
Ralston, J. M. and Lorimor, O. G., "Degradation of Bulk Electroluminescent Efficiency in Zn, O-Doped GaP LED's," July 1977, 3 pp. (Reprinted from IEEE Transactions on Electron Devices, Vol. ED-24, No. 7, July 1977)

PP 197
Wells, Anthony R., "The Centre for Naval Analyses," 14 pp., Dec 1977, AD A049 107

PP 198
Classen, Kathleen P., "The Distributional Effects of Unemployment Insurance," 25 pp., Sept. 1977 (Presented at a Hoover Institution Conference on Income Distribution, Oct 7-8, 1977), AD A054 423

PP 199
Durch, William J., "Revolution From A F.A.R. – The Cuban Armed Forces in Africa and the Middle East," Sep 1977, 16 pp., AD A046 268

PP 200
Powers, Bruce F., "The United States Navy," 40 pp. Dec 1977 (Published as a chapter in The U.S. War Machine by Salamander Books, England, 1978), AD A049 108

PP 201
Durch, William J., "The Cuban Military in Africa and The Middle East: From Algeria to Angola," Sep 1977, 67 pp., AD A045 675

PP 202
Feldman, Paul, "Why Regulation Doesn't Work," (Reprinted from Technological Change and Welfare in the Regulated Industries, Brookings Reprint 219, 1971, and Review of Social Economy, Vol. XXIX, March, 1971, No. 1.) Sep 1977, 8 pp.

PP 203
Feldman, Paul, "Efficiency, Distribution, and the Role of Government in a Market Economy," (Reprinted from The Journal of Political Economy, Vol. 79, No. 3, May/June 1971.) Sep 1977, 19 pp., AD A045 675

PP 204
Wells, Anthony R., "The 1967 June War: Soviet Naval Diplomacy and The Sixth Fleet – A Re-appraisal," Oct 1977, 36 pp., AD A047 236

PP 205
Coile, Russell C., "A Bibliometric Examination of the Square Root Theory of Scientific Publication Productivity," (Presented at the annual meeting of the American Society for Information Science, Chicago, Illinois, 29 September 1977.) Oct 1977, 6 pp., AD A047 237

PP 206
McConnell, James M., "Strategy and Missions of the Soviet Navy in the Year 2000," 48 pp., Nov 1977 (Presented at a Conference on Problems of Sea Power as we Approach the 21st Century, sponsored by the American Enterprise Institute for Public Policy Research, 6 October 1977, and subsequently published in a collection of papers by the Institute), AD A047 244

PP 207
Goldberg, Lawrence, "Cost Effectiveness of Potential Federal Policies Affecting Research & Development Expenditures in the Auto, Steel and Food Industries," 36 pp., Oct 1977 (Presented at Southern Economic Association Meetings beginning 2 November 1977), AD A046 269

PP 208
Roberts, Stephen S., "The Decline of the Overseas Station Fleets: The United States Asiatic Fleet and the Shanghai Crisis, 1932," 18 pp., Nov 1977 (Reprinted from The American Neptune, Vol. XXXVII, No. 3, July 1977), AD A047 245

PP 209 – Classified

PP 210
Kassing, David, "Protecting The Fleet," 40 pp., Dec 1977 (Prepared for the American Enterprise Institute Conference on Problems of Sea Power as We Approach the 21st Century, October 6-7, 1977), AD A049 109

PP 211
Mizrahi, Maurice M., "On Approximating the Circular Coverage Function," 14 pp., Feb 1978, AD A054 429

PP 212
Mangel, Marc, "On Singular Characteristic Initial Value Problems with Unique Solutions," 20 pp., Jun 1978, AD A058 535

PP 213
Mangel, Marc, "Fluctuations in Systems with Multiple Steady States. Application to Lanchester Equations," 12 pp., Feb 78, (Presented at the First Annual Workshop on the Information Linkage Between Applied Mathematics and Industry, Naval PG School, Feb 23-25, 1978), AD A071 472

PP 214
Weinland, Robert G., "A Somewhat Different View of The Optimal Naval Posture," 37 pp., Jun 1978 (Presented at the 1976 Convention of the American Political Science Association (APSA/IUS Panel on "Changing Strategic Requirements and Military Posture"), Chicago, Ill., September 2, 1976), AD A056 228

PP 215
Coile, Russell C., "Comments on: Principles of Information Retrieval by Manfred Kochen," 10 pp., Mar 78, (Published as a Letter to the Editor, Journal of Documentation, Vol. 31, No. 4, pages 298-301, December 1975), AD A054 426

PP 216
Coile, Russell C., "Lotka's Frequency Distribution of Scientific Productivity," 18 pp., Feb 1978, (Published in the Journal of the American Society for Information Science, Vol. 28, No. 6, pp. 366-370, November 1977), AD A054 425

PP 217
Coile, Russell C., "Bibliometric Studies of Scientific Productivity," 17 pp., Mar 78, (Presented at the Annual meeting of the American Society for Information Science held in San Francisco, California, October 1976), AD A054 442

PP 218 – Classified.

PP 219
Huntzinger, R. LaVar, "Market Analysis with Rational Expectations: Theory and Estimation," 60 pp., Apr 78, AD A054 422

PP 220
Maurer, Donald E., "Diagonalization by Group Matrices," 26 pp., Apr 78, AD A054 443

PP 221
Weinland, Robert G., "Superpower Naval Diplomacy in the October 1973 Arab-Israeli War," 76 pp., Jun 1978 (Published in Seapower in the Mediterranean: Political Utility and Military Constraints, The Washington Papers No. 61, Beverly Hills and London: Sage Publications, 1979) AD A055 564

PP 222
Mizrahi, Maurice M., "Correspondence Rules and Path Integrals," 30 pp., Jun 1978 (Invited paper presented at the CNRS meeting on "Mathematical Problems in Feynman's Path Integrals," Marseille, France, May 22-26, 1978) (Published in Springer Verlag Lecture Notes in Physics, 106, (1979), 234-253) AD A055 536

PP 223
Mangel, Marc, "Stochastic Mechanics of Molecule-Ion Molecule Reactions," 21 pp., Jun 1978, AD A056 227

PP 224
Mangel, Marc, "Aggregation, Bifurcation, and Extinction In Exploited Animal Populations*," 48 pp., Mar 1978, AD A058 536
*Portions of this work were started at the Institute of Applied Mathematics and Statistics, University of British Columbia, Vancouver, B.C., Canada

PP 225
Mangel, Marc, "Oscillations, Fluctuations, and the Hopf Bifurcation*," 43 pp., Jun 1978, AD A058 537
*Portions of this work were completed at the Institute of Applied Mathematics and Statistics, University of British Columbia, Vancouver, Canada.

PP 226
Ralston, J. M. and J. W. Mann*, "Temperature and Current Dependence of Degradation in Red-Emitting GaP LEDs," 34 pp., Jun 1978 (Published in Journal of Applied Physics, 50, 3630, May 1979) AD A058 538
*Bell Telephone Laboratories, Inc.

PP 227
Mangel, Marc, "Uniform Treatment of Fluctuations at Critical Points," 50 pp., May 1978, AD A058 539

PP 228
Mangel, Marc, "Relaxation at Critical Points: Deterministic and Stochastic Theory," 54 pp., Jun 1978, AD A058 540

PP 229
Mangel, Marc, "Diffusion Theory of Reaction Rates, I: Formulation and Einstein-Smoluchowski Approximation," 50 pp., Jan 1978, AD A058 541

PP 230
Mangel, Marc, "Diffusion Theory of Reaction Rates, II Ornstein-Uhlenbeck Approximation," 34 pp., Feb 1978, AD A058 542

PP 231
Wilson, Desmond P., Jr., "Naval Projection Forces: The Case for a Responsive MAF," Aug 1978, AD A058 543

PP 232
Jacobson, Louis, "Can Policy Changes Be Made Acceptable to Labor?" Aug 1978 (Submitted for publication in Industrial and Labor Relations Review), AD A061 528

PP 233
Jacobson, Louis, "An Alternative Explanation of the Cyclical Pattern of Quits," 23 pp., Sep 1978

PP 234 – Revised
Jondrow, James and Levy, Robert A., "Does Federal Expenditure Displace State and Local Expenditure: The Case of Construction Grants," 25 pp., Oct 1979, AD A061 529

PP 235
Mizrahi, Maurice M., "The Semiclassical Expansion of the Anharmonic-Oscillator Propagator," 41 pp., Oct 1978 (Published in Journal of Mathematical Physics 20 (1979), pp. 844-855), AD A061 538

PP 237
Maurer, Donald, "A Matrix Criterion for Normal Integral Bases," 10 pp., Jan 1979 (Published in the Illinois Journal of Mathematics, Vol. 22 (1978), pp. 672-681

PP 238
Utgoff, Kathleen Classen, "Unemployment Insurance and The Employment Rate," 20 pp., Oct 1978 (Presented at the Conference on Economic Indicators and Performance: The Current Dilemma Facing Government and Business Leaders, presented by Indiana University Graduate School of Business), AD A061 527

PP 239
Trost, R. P. and Warner, J. T., "The Effects of Military Occupational Training on Civilian Earnings: An Income Selectivity Approach," 38 pp., Nov 1979, AD A077 831

PP 240
Powers, Bruce, "Goals of the Center for Naval Analyses," 13 pp., Dec 1978, AD A063 759

PP 241
Mangel, Marc, "Fluctuations at Chemical Instabilities," 24 pp., Dec 1978 (Published in Journal of Chemical Physics, Vol. 69, No. 8, Oct 15, 1978), AD A063 787

PP 242
Simpson, William R., "The Analysis of Dynamically Interactive Systems (Air Combat by the Numbers)," 160 pp., Dec 1978, AD A063 760

PP 243
Simpson, William R., "A Probabilistic Formulation of Murphy Dynamics as Applied to the Analysis of Operational Research Problems," 18 pp., Dec 1978, AD A063 761

PP 244
Sherman, Allan and Horowitz, Stanley A., "Maintenance Costs of Complex Equipment," 20 pp., Dec 1978 (Published By The American Society of Naval Engineers, Naval Engineers Journal, Vol 91, No 6, Dec 1979) AD A071 473

PP 245
Simpson, William R., "The Accelerometer Methods of Obtaining Aircraft Performance from Flight Test Data (Dynamic Performance Testing)," 403 pp., Jun 1979, AD A075 226

PP 246
Brechling, Frank, "Layoffs and Unemployment Insurance," 35 pp., Feb 1979 (Presented at the NBER Conference on "Low Income Labor Markets," Chicago, Jun 1978)

PP 248
Thomas, James A., Jr., "The Transport Properties of Dilute Gases in Applied Fields," 183 pp., Mar 1979

PP 249
Glasser, Kenneth S., "A Secretary Problem with a Random Number of Choices," 23 pp., Mar 1979

PP 250
Mangel, Marc, "Modeling Fluctuations in Macroscopic Systems," 26 pp., Jun 1979

PP 251
Trost, Robert P., "The Estimation and Interpretation of Several Selectivity Models," 37 pp., Jun 1979, AD A075 941

PP 252
Nunn, Walter R., "Position Finding with Prior Knowledge of Covariance Parameters," 5 pp., Jun 1979 (Published in IEEE Transactions on Aerospace & Electronic Systems, Vol. AES-15, No. 3, March 1979

PP 253
Glasser, Kenneth S., "The d-Choice Secretary Problem," 32 pp., Jun 1979, AD A075 225

PP 254
Mangel, Marc and Quanbeck, David B., "Integration of a Bivariate Normal Over an Offset Circle," 14 pp., Jun 1979

PP 255 – Classified, AD B051 441L

PP 256
Maurer, Donald E., "Using Personnel Distribution Models," 27 pp., Feb 1980, AD A082 218

PP 257
Thaler, R., "Discounting and Fiscal Constraints Why Discounting is Always Right," 10 pp, Aug 1979, AD A075 224

PP 258
Mangel, Marc S. and Thomas, James A., Jr "Analytical Methods in Search Theory," 86 pp, Nov 1979, AD A077 832

PP 259
Glass, David V., Hsu, Ih Ching, Nunn, Walter R and Perin, David A., "A Class of Commutative Markov Matrices," 17 pp., Nov 1979, AD A077 833

PP 260
Mangel, Marc S. and Cope, Davis K., "Detection Rate and Sweep Width in Visual Search," 14 pp Nov 1979, AD A077 834

PP 261
Vila, Carlos L., Zvijac, David J and Ross, John, "Franck Condon Theory of Chemical Dynamics VI Angular Distributions of Reaction Products," 14 pp., Nov 1979 (Reprinted from Journal Chem Phys 70(12), 15 Jun 1979), AD A076 287

PP 262
Petersen, Charles C., "Third World Military Elites in Soviet Perspective," 50 pp, Nov 1979 AD A077 835

PP 263
Robinson, Kathy I., "Using Commercial Tankers and Containerships for Navy Underway Replenishment," 25 pp, Nov 1979, AD A077 836

PP 264
Weinland, Robert G., "The U.S. Navy in the Pacific Past, Present, and Glimpses of the Future," 31 pp, Nov 1979 (Delivered at the International Symposium on the Sea, sponsored by the International Institute for Strategic Studies, The Brookings Institution and the Yomiuri Shimbun Tokyo, 16 20 Oct 1978) AD A066 837

PP 265
Weinland, Robert G., "War and Peace in the North Some Political Implications of the Changing Military Situation in Northern Europe," 18 pp, Nov 1979 (Prepared for presentation to the "Conference of the Nordic Balance in Perspective The Changing Military and Political Situation," Center for Strategic and International Studies Georgetown University, Jun 15 16, 1978) AD A077 838

PP 266
Utgoff, Kathy Classen, and Brechling, Frank, "Taxes and Inflation," 25 pp, Nov 1979 AD A081 194

PP 267
Trost, Robert P., and Vogel Robert C., "The Response of State Government Receipts to Economic Fluctuations and the Allocation of Counter Cyclical Revenue Sharing Grants," 12 pp Dec 1979 (Reprinted from the Review of Economics and Statistics Vol LXI No 3 August 1979)

PP 268
Thomason, James S., "Seaport Dependence and Inter State Cooperation The Case of Sub Saharan Africa," 141 pp, Jan 1980 AD A081 193

PP 269
Weiss, Kenneth G., "The Soviet Involvement in the Ogaden War," 42 pp, Jan 1980 (Presented at the Southern Conference on Slavic Studies in October 1979), AD A082 219

PP 270
Remnek, Richard, "Soviet Policy in the Horn of Africa The Decision to Intervene," 52 pp, Jan 1980 (To be published in "The Soviet Union in the Third World Success or Failure," ed by Robert H Donaldson Westview Press, Boulder, Co., Summer 1980), AD A081 195

PP 271
McConnell James, "Soviet and American Strategic Doctrines One More Time," 43 pp, Jan 1980, AD A081 192

PP 272
Weiss Kenneth G., "The Azores in Diplomacy and Strategy, 1940 1945, 46 pp, Mar 1980, AD A085 094

PP 273
Nakada, Michael K., "Labor Supply of Wives with Husbands Employed Either Full Time or Part Time," 39 pp, Mar 1980, AD A082 220

PP 275
Goldberg Lawrence, "Recruiters Advertising and Navy Enlistments," 34 pp, Mar 1980, AD A082 221

PP 276
Goldberg Lawrence, "Delaying an Overhaul and Ship's Equipment," 40 pp, May 1980, AD A085 095

PP 277
Mangel, Marc, "Small Fluctuations in Systems with Multiple Limit Cycles," 19 pp, Mar 1980 (Published in SIAM J Appl Math Vol 38 No 1 Feb 1980) AD A086 229

PP 278
Mizrahi, Maurice, "A Targeting Problem Exact vs Expected Value Approaches," 23 pp, Apr 1980 AD A085 096

PP 279
Walt Stephen M., "Causal Inferences and the Use of Force A Critique of Force Without War," 50 pp, May 1980, AD A085 097

PP 280
Goldberg Lawrence, "Estimation of the Effects of A Ship's Steaming on the Failure Rate of Its Equipment An Application of Econometric Analysis," 25 pp, April 1980 AD A085 098

PP 281
Mizrahi, Maurice M., "Comment on 'Discretization Problems of Functional Integrals In Phase Space'," pp., May 1980

PP 283
Dismukes, Bradford, "Expected Demand for the U.S. Navy to Serve as An Instrument of U.S. Foreign Policy Thinking About Political and Military Environmental Factors," 30 pp., April 1980, AD A085 099

PP 284
J Keilson,* W Nunn, and U Sumita,** "The Laguerre Transform," 119 pp, May 1980
*The Graduate School of Management, University of Rochester and the Center for Naval Analyses
**The Graduate School of Management, University of Rochester, AD A085 100

PP 285
Remnek, Richard B., "Superpower Security Interests in the Indian Ocean Area," 26 pp., Jun 1980 AD A087 113

PP 286
Mizrahi, Maurice M., "On the WKB Approximation to the Propagator for Arbitrary Hamiltonians," 25 pp, Aug 1980

PP 287
Cope, Davis, "Limit Cycle Solutions of Reaction Diffusion Equations," 325 pp., June 1980 AD A087 114

PP 288
Golman, Walter, "Don't Let Your Slides Flip You A Painless Guide to Visuals That Really Aid," 28 pp., Oct 1980

PP 289
Robinson, Jack, "Adequate Classification Guidance -- A Solution and a Problem," 7 pp., August 1980

PP 290
Watson, Gregory H. "Evaluation of Computer Software in an Operational Environment," 17 pp., Aug 1980

PP 291
Maddala, G.S.* and Trost, R. P., "Some Extensions of the Nerlove Press Model," 17 pp., Oct 1980
*University of Florida

PP 292
Thomas, Jr., James A., "The Transport Properties of Binary Gas Mixtures in Applied Magnetic Fields," 10 pp., Sept 1980 (Published in Journal of Chemical Physics 72 (10), 15 May 1980

PP 293
Thomas, Jr., James A., "Evaluation of Kinetic Theory Collision Integrals Using the Generalized Phase Shift Approach," 12 pp, Sept 1980 (Printed in Journal of Chemical Physics 72 (10), 15 May 1980

PP 294
Roberts Stephen S., "French Naval Policy Outside of Europe," 30 pp, Sept 1980 (Presented at the Conference of the Section on Military Studies, International Studies Association Kiawah Island, S.C.)

PP 295
Roberts, Stephen S., "An Indicator of Informal Empire Patterns of U.S. Navy Cruising on Overseas Stations, 1869 1897," 40 pp., Sept 1980 (Presented at Fourth Naval History Symposium, US Naval Academy, 26 October 1979

PP 296
Dismukes, Bradford and Petersen, Charles C., "Maritime Factors Affecting Iberian Security," (Factores Marítimos Que Afectan La Securidad Ibérica) 14 pp, Oct 1980

PP 297 - Classified

DATE
FILMED